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HELIOTYPE PRINTING CO., BOSTON.

SÈVRES VASE.

Awarded to "Machines of Exceptional Merit," at the Field Trials of Agricultural Implements.

Universal Exposition at Paris, 1878.

REPORTS

OF THE

UNITED STATES COMMISSIONERS

TO THE

PARIS UNIVERSAL EXPOSITION,

1878.

PUBLISHED UNDER DIRECTION OF THE COMMISSIONER-GENERAL
BY AUTHORITY OF CONGRESS

VOLUME V.

AGRICULTURAL IMPLEMENTS, AGRICULTURAL PRODUCTS AND FOOD,
HORTICULTURE, VITICULTURE

WASHINGTON
GOVERNMENT PRINTING OFFICE
1880

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AGRICULTURAL IMPLEMENTS.

EDWARD H. KNIGHT, LL. D.

[Extract from the Official Classification.]

EIGHTH GROUP.—AGRICULTURE AND PISCICULTURE.

CLASS 76.—SPECIMENS OF FARM BUILDINGS AND AGRICULTURAL WORKS.

* * * * * * *

Apparatus for preparing the food of animals.

Agricultural machinery in motion: steam-plows, reaping and mowing machine, hay-making machines, thrashing machines, etc.

* * * * * * *

Presses for wine, cider, oil.

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INTRODUCTORY.

Subjects included in this report.

The notices of agricultural machinery embraced in this report are principally—

1. Those which have some peculiar features not usual in our machines of the same class.

2. Machines which were entered and operated in the series of field trials in the vicinity of Paris during the summer of 1878.

Not all exhibits in Class 76 entered for competition in the field trials.

Some American exhibits which came within the range of Class 76 were not entered for competition, and, in fact, many of them were outside of the classes invited to the *essais*.

Some of these were superior to any similar machines or apparatus exhibited from other countries, but, being familiar to our own people, need not occupy space here.

To indicate clearly what is meant, some instances may be cited:

Instances.

The windmill of the United States Windmill, Engine, and Pump Company, and the "Eclipse" windmill.

The Fairbanks weighing machines for live stock and farm produce, which carried the palm over all competitors.

The Howe scales, in fine finish and variety.

The Reynolds fruit-drier; etc., etc.

THE JURY OF CLASS 76.

Jury in Class 76

The jury of Class 76 was composed of the following persons, preserving the order in the official list:

MM.

KNIGHT (Dr. EDWARD H.), C. E., Hon. Commissioner...United States.
STERSTEVENS (L.), Commissaire de Belgique.....Belgium.
FOUCHER DE CAREIL, Sénateur .....France.
GIRARD (AIMÉ), Professeur au Conservatoire et à l'Institut Agronomique.....France.
RONNA (A.), C. E .....France.
LECOUTEUX, Professeur à l'Institut Agronomique.....France.
RISLER, Professeur à l'Institut Agronomique .....France.
MURET (H.).....France.
PETIT.....France.
LAVALARD (E.) .....France.
Le Baron de LADOUCETTE (E.), Député.....France.
TRESCA (A.), Répétiteur à l'Institut Agronomique .....France.

Medals granted to United States exhibitors in Class 76.

LIST OF MEDALS GRANTED TO UNITED STATES EXHIBITORS IN CLASS 76, PARIS EXPOSITION, 1878

GRAND PRIZES.

Department of Agriculture	Washington, D. C	Collective exhibit.
Cyrus H. McCormick	Chicago, Ill.	Binding-reaper.

GOLD MEDALS.

Case, J. J	Racine, Wis	Reaper and thrasher.
Dederick (P. K.) & Co	Albany, N. Y	Hay-press.
Deere & Co	Moline, Ill	Plows and cultivator.
Dodds, J	Dayton, Ohio	Horse hay-rake.
Fairbanks & Co	Saint Johnsbury, Vt.	Cattle and hay scales.
Farmers' Friend Manufacturing Company	Dayton, Ohio	Grain and fertilizer-drills.
Gale Manufacturing Co	Albion, Mich	Plows.
Globe Horseshoe Nail Co	Boston, Mass	Horseshoe nails.
Johnston Harvester Co	Brockport, N. Y	Harvesters.
Osborne (D. M.) Manuf. Co.	Auburn, N. Y	Harvesters.
Reynolds, A. J	Chicago, Ill	Fruit-drier.
Warder, Mitchell, & Co	Springfield, Ohio	Harvesters.
Wood, Walter A	Hoosick Falls, N. Y.	Harvesters.
Wood, William Anson	Albany, N. Y	Harvesters.

SILVER MEDALS.

Adriance, Platt, & Co	New York, N. Y	Harvesters.
Aultman & Co	Canton, Ohio	Harvesters.
Bay State Rake Company	Winchendon, Mass	Horse hay-rake.
Coates & Co	Alliance, Ohio	Horse hay-rake.
Curtis, J. M	San Francisco, Cal.	Wine-heater.
Farquhar, A. B	York, Pa	Thrasher and plows.
Hercules Lever-jack Co	Newark, N. J	Lifting-jack.
Howe Scale Company	Rutland, Vt	Cattle and hay scales.
Knight, Harold E	Bellefontaine, Ohio	Maple sugar and sirup.
Speer & Sons	Pittsburgh, Pa	Plows.
Stratton & Cullum	Meadville, Pa	Hay-loader.
U. S. Windmill, Engine, and Pump Company	Batavia, Ill	Windmill and pump.

BRONZE MEDALS.

Bickford & Huffman	Macedon, N. Y	Grain-drill.
Graham, Emlen, & Passmore	Philadelphia, Pa	Lawn-mower.
Hill's Archimedean Lawn-mower Company	Hartford, Conn	Lawn-mower.
Markt & Co	New York, N. Y	Horse hay-rake.
Randolph, T. F	Morristown, N. J	Ditching machine.
Stoddard & Co	Dayton, Ohio	Grain-drill.
Taylor Manufacturing Co.	Westminster, Md	Thrasher.

FIELD TRIALS.

Field trials.

Ordered in the "Regulations" published in 1876.

The trials of agricultural implements in the field were determined upon as early as the year 1876, when the "Addition to the General Regulations" announced the following:

[Translation.]

"SPECIAL DIRECTIONS TO FRENCH AND FOREIGN EXHIBITORS IN THE GROUP OF AGRICULTURE (GROUP VIII).

* * * * *

Extract from *Réglement Général*, 1876.

"ARTICLE 16.—*Agricultural machines and implements. Successive competitive trials.*

"Besides the conditions determined by the 'General Regulations' [September 7, 1876], a series of competitive trials is ordered for agricultural machines and apparatus, the results of which will be considered in the determination of the awards.

"These trials will succeed each other in the following order:

"FIRST SERIES.—*Machines and instruments used in the culture and preparation of the soil.*

"Extirpators, scarifiers, ditchers, draining apparatus, plows of all sorts, harrows, rollers, hydraulic machines, steam-plows, and their appurtenances.

"SECOND SERIES.—*Machines and instruments used in sowing grain or fertilizers, and the cultivation of crops in drills.*

"Fertilizer-distributors, seeding machines of all kinds, horse-hoes, ridging plows.

"THIRD SERIES.—*Machines and instruments belonging to the culture or care of hay crops.*

"Mowers, hay-tedders, rakes, and other apparatus belonging to the hay field, the packing, baling, or preservation of hay.

"FOURTH SERIES.—*Machines and implements for reaping.*

"Reaping machines, apparatus for the harvesting of cereals, their preservation in fitful weather, their transportation and preservation.

"FIFTH SERIES.—*Machines and apparatus for the thrashing and cleaning of cereals and other plants, and the preparation of food for domestic animals.*

"Thrashing machines, riddles, fanning mills, grain-cleaners, granaries, straw-cutters, feed grinders and crushers, root-cutters, etc.

Field trials. "ARTICLE 17.—*Times determined for the trials of agricultural machines and implements.*

Extract from *Réglement Général*, 1876.

"The first two series of trials will take place during the month of May, the third and fourth series in the months of June and July, and the fifth series in the month of August.

"All the arrangements will be made in order that these trials of machines and instruments shall be as full as possible, and of such sort as to demonstrate on the one hand the force required, and on the other the cost—in one word, the valuable effect.

"During each of these trials the exhibitors or their agents will hold themselves at the disposition of the jury, and furnish in duplicate the teams, apparatus, and machines which may be necessary in the trials.

* * * * *

"Paris, December 1, 1876.

"*Le Sénateur, Commissaire-Général :*

"J.-B KRANTZ."

Appendix 1, containing the classification.

The "Appendix No. 1" to the French "General Regulations" of September 1, 1876, contained the "System of General Classification," and agricultural implements were mentioned in two classes:

[Translation.]

"SIXTH GROUP.

* * * * *

Class 51.

"CLASS 51.—*Agricultural implements and processes used in the cultivation of fields and forests.*

"Plans of culture; distribution and management of crops. Apparatus and works for agricultural engineering, draining, irrigation, etc. Plans and models of farm buildings.

"Tools, implements, machines, and apparatus used in husbandry, sowing and planting, harvesting, preparation and preservation of crops.

"Various agricultural machines worked by horse-power or by steam, etc., etc."

"EIGHTH GROUP.

Class 76.

"CLASS 76.—*Specimens of farm buildings and agricultural works.*

* * * * *

"Apparatus for preparing the feed of animals.

"Agricultural machinery in motion: steam-plows, reap-

ing and mowing machines, hay-making machines, thrashing machines, etc."

Field trials.

* * * * *

This duplication of statement caused some difficulty all the way through.

Difficulties arising from citation of agricultural machinery in two groups and classes.

It seems to have been regarded as optional on the part of exhibitors whether to place their machines in Class 51 or Class 76.

The French exhibitors generally chose Class 76, and the exhibits from the United States were entered in the same class before leaving our shores.

The English machines were all entered in Class 51; English colonies the same; Norway, Sweden, Japan, China, Spain, Russia, in Class 51; Austria-Hungary, Switzerland, in both; Belgium in 51; Greece in neither; Denmark in both; Italy in 51.

Work of the respective juries of classes.

Jurors were appointed in each class, and commenced their work, viewing the same machines, the class juries sometimes finding themselves face to face regarding the same implement. As the principal apparent result would be the granting of duplicate medals, which was not a concern of theirs, the affair was entirely amicable; but the exhibitors testified a laudable desire to get a full share of anything good in prospect, and commenced entering in the other class, whichever it might be; the English and others putting themselves in Class 76, and the Americans, nothing loth, enrolling themselves in Class 51.

Class 51: machines at rest.

Class 76: machines in motion.

As Class 51 had the machines at rest and Class 76 the same machines in motion, it became an interesting problem with the exhibitors, when a jury was seen approaching, to know which it might be, and either to cast off or put on the belt by which the machine derived its motion from the engine which ran the machines in the agricultural annex. As errors sometimes occurred, the jurors in Class 51 saw a machine in motion and Class 76 in a state of perfect and entire repose, which changed to hysterical activity when the exhibitor found out his mistake.

The result, as exhibited in the awards, shows how much the work was duplicated, and the respective values of the medals show the relative appreciation by the respective juries of the same machines. The correspondence of the estimates was, however, pretty close.

Sir P. Cunliffe Owen.

The English acting Commissioner-General, a most active and able executive officer, with perhaps a greater experience in such matters than any one else in the whole *personnel* of the Exposition, took exception at an early date to the

Field trials. field trials, as the English had determined not to enter upon them. The matter long hung doubtful, and it is probable that this serious opposition caused the delay and the change of the times and order of the series of trials.

English objection to.

American desire to secure trials in the field.

The United States juror in the class strongly insisted that the original plan should be carried out. The French Direction of Agriculture, presided over by M. Eugène Tisserand, and the jury of Class 76 were like-minded; and the following programme for the trials was issued on the 14th of June, a time when it was originally expected that one-half of the trials would have been concluded. The first trial actually took place July 22:

Original programme to be carried out.

[Translation.]

Special regulations for the field trials.

"SPECIAL REGULATIONS FOR THE TRIALS OF AGRICULTURAL MACHINES ON THE GROUND.

"1. The trials of the agricultural machines will take place in the vicinity of Paris. The machines will be operated under their ordinary working conditions and for a sufficient time to permit the proper estimation of their value.

"2. These trials apply to the French and foreign machines belonging to the following groups:

Classes of machines to be tried.

"1. *Mowers, tedders, rakes, and portable hay-presses.*

"2. *Reaping machines and binding-reapers.*

"3. *Appliances for the preparation of the soil, plows and instruments for breaking or clearing the soil, worked by teams or by steam; gang-plows, draining machines, etc.*

"Other agricultural machines, not included in the above category, will be tried also if deemed of sufficient importance.

Notices of place of trial.

"3. These trials will be had at places to be hereafter determined.

Directions to intending competitors.

"4. The exhibitors who wish to take part in these trials must make it known in writing before the 30th of June.

"5. The Director of the Sections of Agriculture and Horticulture, on the recommendation either of the foreign commissioners or of the committees of admission, shall designate the machines to be admitted to the trials; these will last at least one day for each group of machines.

Designation of machines to be tried.

Place in field designated by lot.

"6. The site on which each machine shall work will be designated by drawing lots between the exhibitors just previous to each trial.

Expenses at cost of exhibitors.

"7. Each contestant will provide, at his own cost and care, the attendants, teams, fuel, and everything necessary for the working of his machines; the cost of transportation, going and returning, being also at his own charge.

"8. Any exhibitor whose machine may be broken or disabled during work may replace it by an identical machine. *Field trials.* Regulations for.

"9. There will be no classification in order of merit.

"10. The accredited delegates of the societies and committees of agriculture of France may follow all the operations, and will then meet at a place to be hereafter designated to make known their opinions on the trials at which they have been present.

"11. The precise date and place for each trial will be made known not less than eight days in advance.

"*Special article.*

"The Director of the Sections of Agriculture and Horticulture, with the advice of the committees, will designate among the machines which have been worked those which shall be the object of dynamometric trials. Selection of machines for dynamometric trials.

"These trials will be made at the laboratory of rural engineering at the Agricultural Institute of Vincennes.

"Paris, June 14, 1878.

"Dressé et approuvé:

"*Le Sénateur, Commissaire-Général,*

"J.-B. KRANTZ.

"Vu et approuvé:

"*Le Ministre de l'Agriculture et du Commerce,*

"TEISSERENC DU BORT.

"NOTE.—Applications for admission to the trials must be made in writing and deposited at the Bureau of the Agricultural Section (*Pavillon de l'Exposition de l'Agriculture, Quai d'Orsay*)." Applications for admission to the trials.

The English protest was repeated upon the reception of the foregoing definite announcement, which was placarded in the building of the *Champ de Mars* and at the Direction of Agriculture on the *Quai d'Orsay.* English protest.

Entries for the trials were made by almost all the nations represented in the agricultural section: England, France, the United States, Canada, Russia, Switzerland, and Italy. After the list of competitors was printed, however, most of the English exhibitors withdrew.* Nations which entered. Withdrawal of the English.

The trials came off as follows:

1*st series.*—At Marmont (*Seine-et-Marne*), July 22, 1878. Including: *Reapers, binding-reapers, combined reapers and* Dates of trials. Marmont.

* At the Vienna Exposition in 1873, at the field trials at Léopoldstadt, July 9 of that year, 19 reapers and 16 mowers started. These were all American, "the English, French, and Germans not thinking it expedient to take part," as M. Tisserand says in his official French report of the Vienna Exposition.

Field trials. Marmont.

mowers, mowers, hay-tedders, horse-rakes, prairie-renovators, hay-loaders, electric apparatus for night work in the fields.

The dynamometrical trials were had at the same place July 25.

Petit-Bourg.

2*d series.*—At Petit-Bourg (*Seine-et-Oise*), July 29, 1878.

Including: *Plows, gang-plows, steam-plows and cultivators, horse-hoes, cultivators, harrows, rollers, ditchers, drills and broadcast sowers for seed and fertilizers.*

The dynamometrical tests were had at the same place August 6.

Esplanade des Invalides.

3*d series.*—At the Exposition grounds on the *Esplanade des Invalides*, August 4.

Including: *Thrashing machines driven by steam or horse power, or by hand for small operations; baling presses for hay or straw.*

Champ de Mars.

4*th series.*—On the lawn of the *Champ de Mars*, August 8.

Including: *Lawn-mowers.*

5*th series.*—Same place, August 9.

Including: *Apparatus for watering lawns and gardens.*

Gonesse.

6*th series.*—At Gonesse (*Seine-et-Oise*), August 12.

Including: *Steam plows and cultivators, for extensive or moderate operations.*

Announcement of the special prizes for exceptional merit.

The announcement that the Minister of Agriculture and Commerce had placed at the disposition of the committee on trials "twelve objects of art" to reward exceptional merit which might be found in any of the competing machines added greatly to the interest which the contestants felt in the result of the trials, but provoked further opposition on the part of those who declined the test.

These special awards were additional to regular medals provided for in *Annexe No.* 1 of the *Règlement Générale.*

Sèvres vases.

It was understood at the time that the *objets d'art* would probably be Sèvres vases worth 1,000 fr. each, and it may be added here, somewhat out of the historical order, that such proved to be the fact when they were received at the State Department, Washington, D. C., in November, 1879, for distribution.

Ultimate decision by the jury on agricultural machinery dependent upon result of field trials.

The work of the jury in Class 76, so far as carried on in the precincts of the *Champ de Mars*, where the machines were exhibited, was not considered final, as the ultimate adjudication was dependent upon the action of the machines at the trials in the field, so far, at least, as those were concerned which took part in them. This was in accordance with article 16 of the "Special Regulations," above quoted.

The constitution of the special jury for reporting upon the field trials was announced in the following letter: Constitution of the special jury in the field.

"Ministère de l'Agriculture et du Commerce.
"Exposition Universelle Internationale de 1878, à Paris.
"Direction de la Section de l'Agriculture et de l'Horticulture.

"QUAI D'ORSAY,
"PAVILLON DE L'AGRICULTURE,
"*Paris le* 19 *Juillet* 1878.

[Translation.]

"SIR: The commission charged with the public trials in the field of the agricultural machinery of the Universal Exposition is composed of the members of the jury and of the committee of admission of Class 76.

"I have, therefore, to ask you once more for your valuable assistance.

"The programme inclosed will inform you of the place where and the day and hour when these public trials will be made.

"Please accept the renewed assurance (etc.).

"The Director of the Sections of Agriculture and Horticulture,
"EUGÈNE TISSERAND. M. Tisserand.

"Dr. EDWARD H. KNIGHT,
"*Member of the International Jury.*"

To this commission was added M. Patinot, the Préfet of the Department of the *Seine et Marne*, and a committee from the Agricultural Society of that Department, in which the trial of reapers, etc., was held. M. Patinot, préfet.

THE FIELD OF PETIT-BOURG.

[See map facing.]

THE PLOW AND CULTIVATOR TRIALS.

Comparison of the plows of various nations.

Considering their common origin, there is a marked difference between the plows of England, the United States, and France. Southern Europe has plows still more primitive, resembling those shown on coins of the period of the Greek occupation of Sicily. It is not easy from the specimens shown at the French Exposition to determine what may be the ordinary plows of Denmark and Sweden, as the plows from those countries are all of iron and copies of the English.

Many exhibits not representative specimens of the country's implements.

In a number of instances one has to regret that the commissioners from the various countries should have judged it advisable to present only their most improved implements, which, as in the cases of Sweden and Denmark just mentioned, are not representative of the countries, being for the most part copies of imported implements. The same difficulty occurred at the Centennial Exhibition in Philadelphia, 1876, though specimens from Java, Tunis, Japan, Siam, British India, Finland, and Brazil enabled one to study implements some of which are as crude as those shown in the Egyptian tombs.

Reference to plow exhibits at the Centennial.

Comparison of the Philadelphia and Paris exhibits in respect of primitive tools.

For some reason unexplained, the collection of primitive tools and implements at Paris was not as good as at Philadelphia, though that of arms was better. The Javanese collection of native implements in Paris was, however, better than any other in that city, and superior to anything of the kind shown at the Centennial Exhibition. It is not the present purpose to write the history of the development of the plow, but it may be remarked, *en passant*, that the original typical form has been preserved in all succeeding ages.

Plow trials, Petit-Bourg, July 29, 1878.

Passing by with regret the archæologic and ethnologic department of the subject, I proceed to consider what the Paris Exposition showed of novelty combined with merit, and to describe the implements competing for the special prizes at Petit-Bourg (*Seine-et-Oise*), France, July 29, 1878.

The trials were ordered by M. Teisserenc du Bort, the Minister of Agriculture and Commerce, in conformity with

the *Règlement Générale*, dated December 1, 1876. Much opposition was made by the secretary of the British Commission, who in fact had charge of the British sections, but the French authorities eventually decided to pursue the course first marked out. *Plow trials, Petit-Bourg.*

The exhibitors at the field trials of July 29 were: French, 24; Italian, 2; American, 5; Hungarian, 1. Nations competing.

The English, with the exception of the steam-plow manufacturers, declined the competition, as did also the Swedish, Danish, and Spanish.

The steam plows and cultivators were tested on two occasions. Steam plows.

The system of Fowler & Co., of Leeds, England, and of Debains, of Saint-Remy, *près* Clairefontaine, France, at Petit-Bourg, July 29. Fowler & Co. Debains.

The system of Aveling & Porter, of Rochester, England, at Gonesse, August 12. Aveling & Porter.

The dynamometrical tests of plows were made at Petit-Bourg, August 6. Dynamometrical tests.

[The subject of steam plows and cultivators is considered after the hand and horse plows.]

Entries at the plow trials.

Entries at the plow trials.

The following is a list of the competitors in the plow trials at Petit-Bourg (*Seine-et-Oise*), July 29, 1878:

Biggi, Piacenza, Italy: 1 ox-plow.

Boitel, Soissons (*Aisne*), France: 3 Brabant plows.

Bosselet, Fontenay-lès-Louvres (*Seine-et-Oise*): 1 stubble plow.

Candelier, Bucquoy (*Pas-de-Calais*): 1 Brabant double plow,* 1 Brabant ~~*trisoc*~~, 1 Brabant *bisoc*.†

Coutelet, Étrépilly (*Seine-et-Marne*): 1 plow.

David, Sarlat (*Dordogne*): 1 plow.

Debains, Saint-Remy (*Seine-et-Oise*): 1 steam-plow.

Decauville, Petit-Bourg (*Seine-et-Oise*): Steam-plows.

Deere & Co., Moline, Ill., U. S.: 1 gang-plow, 1 plow, 1 sulky-plow.

Depoix, Chapelle-en-Serval (*Oise*): 1 iron plow.

Delahaie-Tailleur & Bajac, Liancourt (*Oise*): 1 Brabant double plow, 1 Brabant plow, 1 *bisoc*, 1 *quatresoc*, 1 draining plow, 1 stubble plow, 1 *trisoc*, 1 ditching plow.

---

*The *double* plow is capable of changing to turn a furrow in either direction; otherwise called a swing-plow, turning plow, hillside plow, etc.

† *Bisoc* and *trisoc* are plows with two or three shares and moldboards, respectively—*i. e.*, gang-plows with two or with three bodies.

Plow trials, Petit-Bourg.

Durand, Montereau (*Seine-et-Marne*): 1 Brabant plow, 1 plow.

Forêt-Collin, Guise (*Aisne*): Brabant double plows.

Gale & Co., Albion, Mich., U. S.: 2 plows.

Garnier, Redon (*Ille-et-Vilaine*): 1 plow, 1 ditching plow.

Henry Frères, Dury-lès-Amiens (*Somme*): 1 Brabant plow, 1 plow (0.25 meter depth), 1 *trisoc.*

Ladislas-Gubiez, Buda-Pest, Hungary: Plows.

Lemaire, Auger, & Amiot, Bresles (*Oise*): Brabant plows, Brabant plows *à bascule.*

Maréchaux, Montmorillon (*Vienne*): 1 plow, 1 ditching plow.

Meixmoron de Dombasle, Nancy (*Meurthe-et-Moselle*): 1 swing-plow, 1 subsoil plow, 1 plow (*avant-train*), *bisocs*, 1 ridging plow.

Entries.

Meugniot Aîné, Dijon (*Côte d'Or*): 1 plow, 1 *bisoc.*

Nicod Frères, Éternoz (*Doubs*): Plows.

Normand-Gourdain, Villers-au-Flos (*Pas-de-Calais*): 1 Brabant double plow.

Parquin, Paris: 1 Parquin plow.

Randolph, Morristown, N. J., U. S.: Ditching machine.

Renault-Gouin, Sainte-Maure (*Indre-et-Loire*): 1 vineyard plow, 1 ridging plow, 1 ditching plow.

Rousselet, Tancrou (*Seine-et-Marne*): 1 stubble plow.

Simond, la Baume (*Doubs*): 1 plow.

Speer & Sons, Pittsburgh, Pa., U. S.: Plows.

Valck-Virey, Saint-Dié (*Vosges*): 1 double-moldboard plow.

Vernhes, Saint-Izaire (*Aveyron*): 1 plow.

Voirin, Manois (*Haute-Marne*): 1 plow.

Wateliez-Delattre, Emmerin (*Nord*): Plows.

(And many others not entered on the printed programme.)

Classification.

Classification.

To render the account more clear the plows will be divided into groups as follows:

1. Single.
2. Turning-moldboard.
3. Subsoil.
4. Draining.
5. Ridging.
6. Clearing.
7. Sulky.
8. Gang.
9. Root-diggers.

Introductory remarks.

Introductory.

The variety of styles and sizes of plows in France is greater than in the United States. Some makers have as many as ten different sizes of a peculiar line of plows.

Plow trials, Petit-Bourg.

France is not so homogeneous a nation as our own, and the influence of the old provincial divisions of Flanders, Normandy, Alsace, Languedoc, Provence, Gascony, etc., is visible in the implements and methods as well as in the persons and language of the peoples. French plow manufacturers who aim at a national reputation and *clientèle* have to bear in mind the prejudices or, perhaps we may say, habits of the different sections; and this increases the variety of the stock in trade, somewhat as in our own case, where the right-hand and the left-hand plows respectively have their admirers. The customs of Central and Southern Ohio and of the South generally differ in this respect from Michigan, the line of the Lakes, and the Eastern States. There is more difference, for instance, between the "Dombasle" plow, made at Nancy, in the old Lorraine, and the *Brabant double*, built at Liancourt or at Rennes, than is to be found between any single-furrow plows built in the United States or between any varieties made in England.

Causes of variety of French plows.

Variety greater in France than with us or in England.

It will not answer the present purpose to show the crude country plows which are still so common in all parts of France, although one may trace the original features in many of the most improved present forms. It is only designed to show those that have merit, and in which certain features of novelty are to be found, which may possibly be suggestive to those engaged in the manufacture of farming implements. Even when the specimen selected for illustration may look more curious than useful, it will be rash to condemn at first sight, for the French are excellent, careful, and successful farmers, and *La Belle France* is no misnomer, for the country is probably the richest, most prosperous, and most beautiful in the world. The farming implements of such a nation, especially when so large a majority of the people is engaged in rural pursuits, cannot but be worthy of attention.

The cruder forms of French plows omitted from the report.

La Belle France.

PLOW TRIALS.

Scene of the plow trials.

The trials of plows at Petit-Bourg took place on the farm of M. Decauville, an area of several hundred acres being placed at the disposal of M. Eugène Tisserand, the Inspector-General of Agriculture of France and director of the trials.

Farm of M. Decauville at Petit-Bourg.

1. *Single plows.*

Single plows.

The French still adhere to a wooden moldboard for certain sandy soils. Such plows weigh from 80 to 240 pounds, according to size, and sell at from 30 to 75 fr. While in England plows have generally two wheels to gage the

Wooden moldboard.

Plow trials.

depth, it is by no means so universal in France, and the cheaper forms of wooden-beam plows, which are sold as low as 35 fr., are frequently wheelless. The French catalogues

Wooden-moldboard plow.

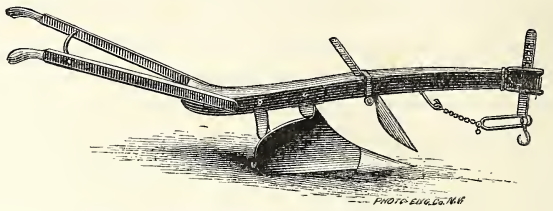


FIG. 1.—*French wooden-moldboard plow.*

divide them into "without wheels," "with one wheel," "with two unequal wheels."

The *charrue à chaîne* (Fig. 2) has two equal-sized wheels,

Plow with draft-chain and fore-carriage.

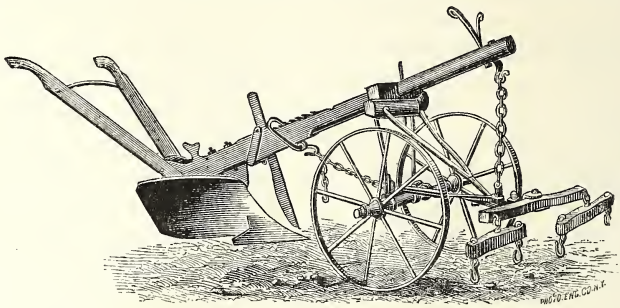


FIG. 2.—*Charrue à chaîne. P. Durand, Montereau, France.*

Normandy plow.

and preserves the general form of the Normandy plow, in which the beam is set at a considerable angle and rests in a seat on the frame of the high fore-carriage (*avant-train*). The double-tree is hitched to the axle of the *avant-train*, and

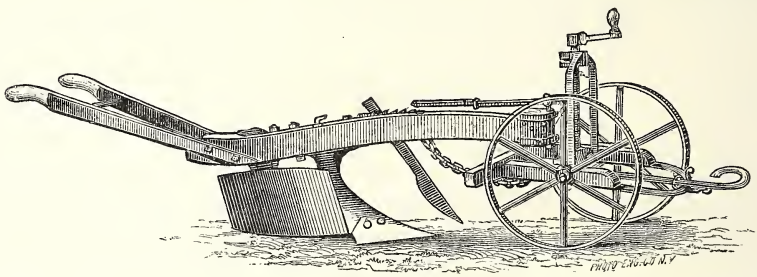


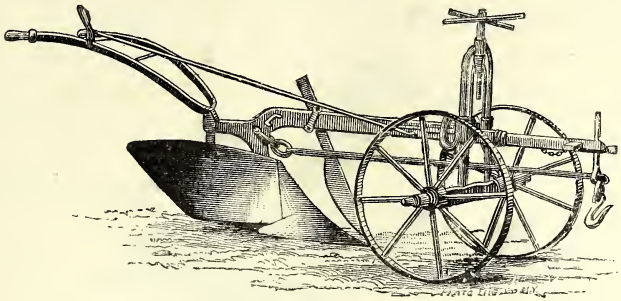
FIG. 3.—*Plow mounted with avant-train. Meixmoron de Dombasle, Nancy, France.*

Plow with fore-carriage.

the latter has a draft-chain to the beam. The implement has a loose and rattling appearance to us, who have more compact arrangements, but it does very good work and maintains its place.

Plow trials.

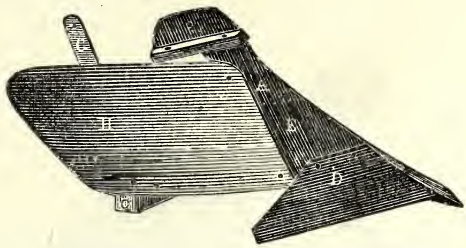
The mode of mounting the plow on the *avant-train* shown in Fig. 3 is one found in the long series of plows manufactured by Meixmoron de Dombasle, of Nancy. The nose of



Brabant single plow.

FIG. 4.—*Brabant simple. P. Durand, Montereau, France.*

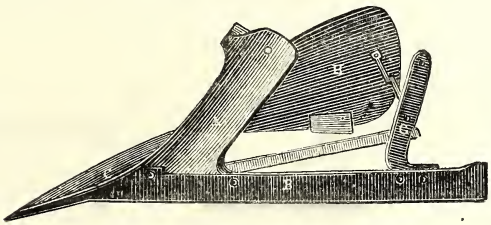
the plow is pivoted to the *avant-train* instead of simply resting upon it and being drawn by a chain. The adjustment for depth of furrow is by the vertical screw, which has a handle above the bridge.



Durand's plow body.

FIG. 5.—*Durand's plow body. View on the moldboard side.*

Another step and we approximate more nearly to the English style—Durand's Brabant *simple*, as distinguished from the *double*, which has a turning moldboard (*tourne oreille*), a left hand and a right hand, so as to plow back



Land-side view.

FIG. 6.—*View on the land side.*

and forth, returning in the last-made furrow, the near and the off horse alternately in the furrow.

In this plow the *avant-train* simply sustains the beam; the draft is by a rod. In the circular handed to the spec-

Plow trials.

tators at the trial it is described as "intended for depths either ordinary or deep. It replaces with great advantage all the ancient models of plows. It will travel alone upon the earth, without need of holding the handles."

Durand's plow, parts detached.

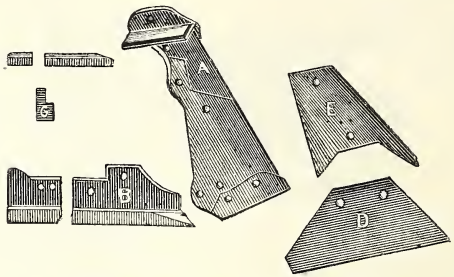


FIG. 7.—*View of the separate pieces of the body, minus the moldboard.*

For the purpose of illustrating the French method of manufacture, it will be as well to dissect one plow. If our people may have the idea of supplying France with plows to the same extent that they now furnish that country with harvesters, the detail may not be thrown away.

View underneath the sole.

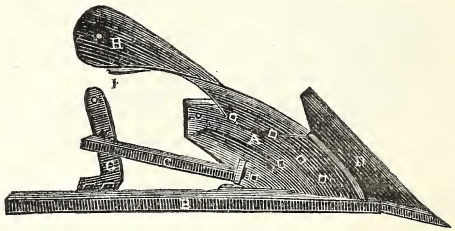


FIG. 8.—*View under the body of the plow.*

Durand's plow bodies are made applicable to any system of plows as well as the Brabant simple. The firm also supplies the parts of the body, which can be mounted on any

French one-wheeled plow.

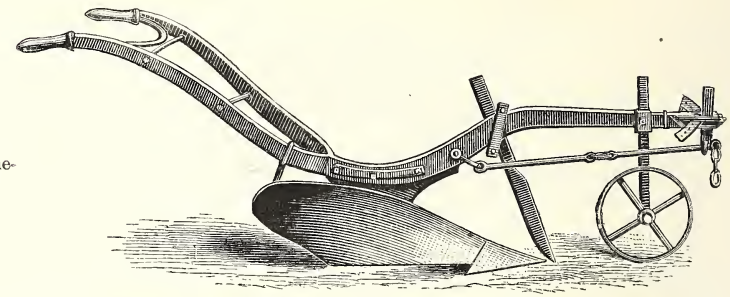


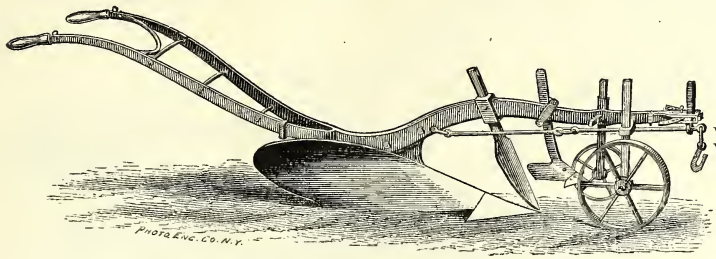
FIG. 9.—*One-wheeled plow. E. Bodin, Rennes, France.*

plow by local shops, according to the custom of the country. They are made either in cast iron or chilled, and in 12

different sizes, from those adapted for 1 horse to those for 12 horses. *Plow trials.*

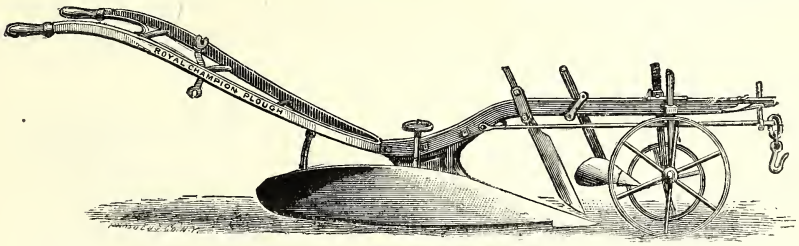
In Figs. 5 to 8 the portions of the plow body are shown. A is the standard; B the sole; C the corner piece; D the share; E the breast covering the front of the standard; F is the heel-piece to prevent wear of the moldboard; G is the rear standard; and H the helicoidal moldboard. Description of detached parts (Figs. 5–8).

The one-wheeled plow of Bodin, of Trois-Croix (Figure 9), dispenses with the *avant-train*, the standard of the gage-wheel passing through a mortise in the beam. The quadrant-clevis permits adjustment for land, and the screw through which the draft-rod passes is the gage for depth. It is very closely on the British model. The French plows in a set, otherwise similar except as to size, are classed, by the length of the moldboard, short, medium, and long (*versoir court, versoir mixte, versoir allongé*). Figs. 9 and 10 show the *versoir allongé*. The mode of fastening the colter by a yoke, shown in Fig. 9, is becoming quite common in several countries. The implement is all of iron. The smallest size is intended for one horse in sandy ground.



French two-wheeled plow, with skim-colter.

FIG. 10.—*Large two-wheeled plow with jointer. E. Bodin, Rennes, France.*



English two-wheeled plow, with skim-colter.

FIG. 11.—*Two-wheeled plow. Lowcock & Barr, Shrewsbury, England.*

Fig. 10 is made in three sizes— Sizes and prices. (Figure 10).

Weight, kilos.	Price, francs.
62	50
72	55
95	75

Bodin's large-sized plow (Figure 10), with two wheels and a jointer, is designed to plow to a depth of 35 centimeters

Plow trials.

(14″) when drawn by 6 horses or oxen. It is used in opening furrows for draining. The weight is 200 kilos and price 230 fr. The skim-colter—the first appearance of which in this country is believed to have been about 30 years ago in the implement known as the "double Michigan plow"—is now becoming quite common in England and France.

The skim-colter.

The plow (Fig. 11) exhibited by Lowcock & Barr, of Shrewsbury, England, only differs from that of Bodin, of Rennes, in some of the details. The moldboard has the

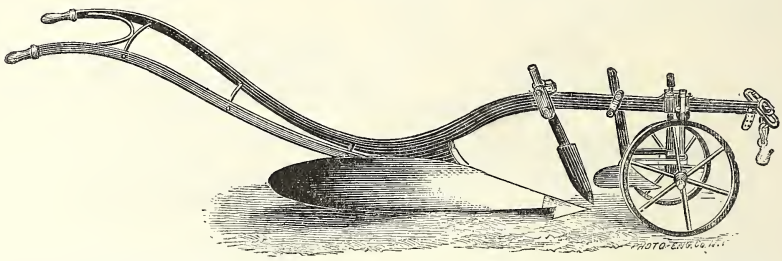


FIG. 12.—"*Bridle*" *pattern wheel plow. Richard Hornsby & Sons, Grantham, England.*

English two-wheeled plows, Lowcock & Barr (Fig. 11),

wedge shape and long rearward extension familiar in the Scotch plows. It has one feature by no means common, a means of adjusting the inclination of the moldboard by a lever or brace operated by a hand-screw.

and Hornsby & Sons (Figure 12).

The plows made by Hornsby & Sons, Grantham, England, are of numerous patterns, with or without the draft-rod, with or without gage-wheels, and the swing-plows are destitute of the jointer. The moldboard has a peculiar convex

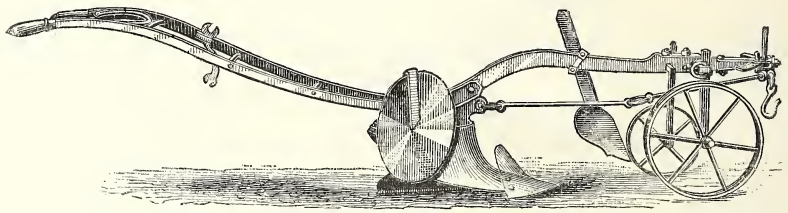


FIG. 13.—*Revolving moldboard plow. Corbett & Peele, Shrewsbury, England.*

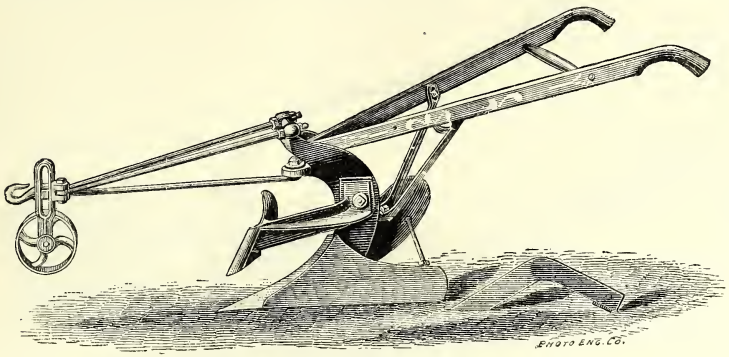
Revolving moldboard plow.

shape much insisted upon by this firm, which appears to have been the first to introduce it. The shares are of cast chilled metal and made self-sharpening. The colter-fastening admits of any rake being given to the colter without holes in the beam. This yoke-fastening is also used largely in the United States upon the Collins plows and others. The frame is of wrought iron. These plows have long been favorites with farmers, and may be taken as the best exemplars of their order and country.

Hornsby's plow.

Plow trials.

The English plows were not shown at the field trial ordered by the Exposition authorities. The reasons for their avoiding the competition can only be guessed at. The opportunity was afforded by a very singular mode of classification, which gave an exhibitor the right to enter his machine in Class 51, or agricultural machinery not in motion (*matériel*

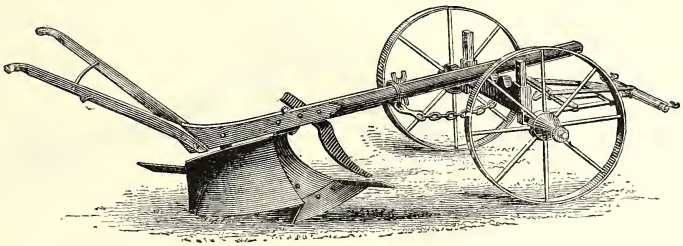


Gale Manufacturing Co.'s rod-beam plow.

FIG. 14.—*Michigan rod-beam plow. Gale Manufacturing Company, Albion, Mich.*

et procédés des exploitations rurales et forestières) or in Class 76, which included agricultural implements in motion (*spécimens d'exploitations rurales et d'usines agricoles*).

The French and Americans entered in Class 76, the English in Class 51. Each class had its jury and worked independently, viewing the same machines and making reports recommending medals. Much duplication of awards ensued, and some curious differences of estimation of the devices by the respective juries.



French movable-point plow.

FIG. 15.—*Movable-point plow. C. Guilleaux, Segré, France.*

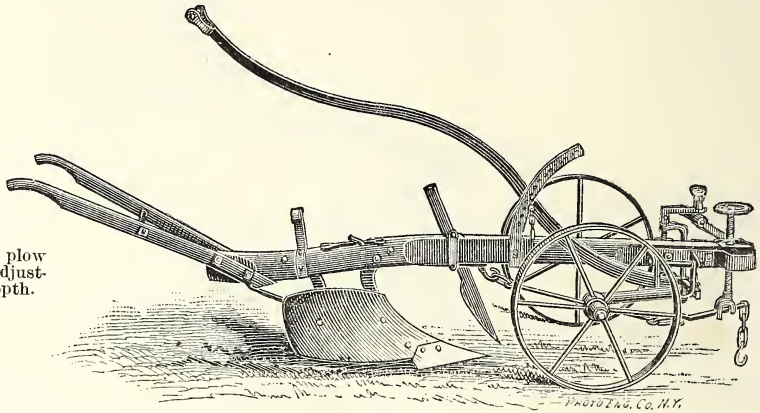
English revolving moldboard plow (Figure 13).

An English plow with a skim-colter was exhibited by Corbett & Peele, of Shrewsbury, England, but this plow had a still more distinguishing peculiarity in its revolving moldboard. This was introduced from the United States into England in 1870, where it appears to meet with some favor, though we see but little of it at home. The price of this plow complete is £5 10*s*. A disk-colter to use in place of the skim-colter is 10 shillings (Figure 13).

Plow trials.

The only American plow which had the skim-colter or small paring share in advance, known also as a *jointer*, and in France as a *rasette*, was the plow exhibited by the Gale Manufacturing Company, of Albion, Mich. This was one of the plows which was exhibited in operation at Petit-Bourg,

Gale plow.

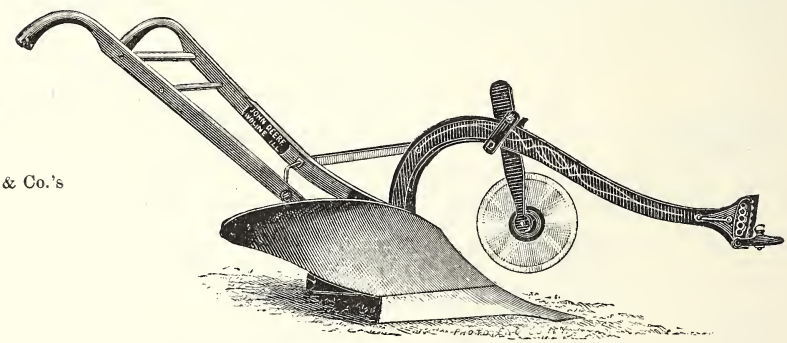


French plow with lever adjustment for depth.

FIG. 16.—*Single plow (monosoo). Meixmoron de Dombasle, Nancy, France.*

and was remarkable for the completeness with which it buried the stubble (Figure 14).

The plow has a peculiar appearance and contains all the adjustments for land and depth in the beam. By loosening the nuts on the rods where they join the standard, the front end of the beam may be pitched downward or upward,



Deere & Co.'s plow.

FIG. 17.—*Iron-beam plow. Deere & Co., Moline, Ill.*

towards the land or away from it, and so give the required set. A colter may be substituted for the jointer, and, being attached to the standard and not to the beam, maintains its adjustment at all times.

French movable-point plow (Figure 15).

Fig. 15, a plow exhibited by Guilleux, of Segré (*Maine-et-Loire*), France, shows another speciality. It has a movable point, which may be thrust forward as it wears. The plow-

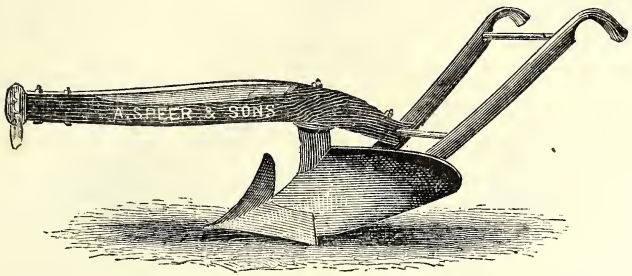
beam riding in a socket on the axle of an *avant-train* and attached by a draft-chain is another illustration of the persistent form so popular in France. The prices are 50, 58, 70, and 85 fr., according to size. The long bar to be shifted forward as it wears, to form a plow-point, was shown at the Centennial in a native plow from Berar, India.

Plow trials.

French movable-point plow (Figure 15).

Fig. 16 shows the two-wheeled single plow made by the firm of Meixmoron de Dombasle, of Nancy (*Meurthe-et-Moselle*). It has a frame entirely of iron and an ordinary size weighs 132 lbs., and costs 85 fr. It is a very good and cheap implement and does excellent work. Its clevis

French two-wheeled plow (Figure 16).



Speer & Sons' center-lever plow.

FIG. 18.—*Center-lever plow. Alexander Speer & Sons, Pittsburgh, Pa.*

arrangement is good, both for draft and depth, and the draft-chain is likewise commendable. The arrangement of the two wheels follows the English form, but the lever is French and is used to lift the front end and tilt up the point, so that the team will draw it out of the ground at the end of the furrow—a very good arrangement, and used also on the gang-plows of France and England, the plowman always walking at work. The sizes, work, and prices are as follows:

Meixmoron de Dombasle's plow (Figure 16).

	Depth of furrow.	Width of furrow.	Number of horses.	Weight.	Price.
	Centimeters	*Centimeters*		*Kilos.*	*Francs.*
Grand monosoc	22 to 28	28 to 34	4 to 6	167	190
Moyen monosoc	15 to 20	22 to 28	3 to 4	155	175
Léger monosoc	11 to 15	18 to 22	2 to 3	135	160

So far, all the plows (with the exception of the wooden-moldboard plow) have been those with *avant-train* or gage-wheels for depth of furrow. The wheelless plow, however, or *swing*-plow, as it is called in England, is more common in the United States, and in fact is sold in Europe as the "American" plow.

At the head of the swing-plows at the Petit-Bourg trials was that exhibited by Deere & Co., of Moline, Ill. (Fig. 17). They are made right or left hand, and of 22 different styles.

Deere & Co.'s plow (Figure 17).

Plow trials.

The high curved beam gives great clearance at the throat. The rolling colter-bar is fastened to the beam by means of a yoke.

Speer & Sons' plow. (Figure 18).

A differently appearing implement, with wooden beam and standing colter, was the center-lever plow of A. Speer & Sons, Pittsburgh, Pa. (Figure 18.)

Reese combination plow.

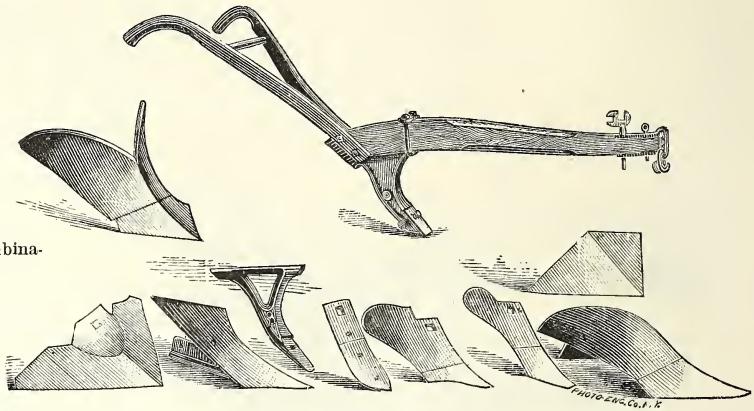


FIG. 19.—*Reese combination plow. A. B. Farquhar, York, Pa.*

A. B. Farquhar.

The Reese combination plow, exhibited by A. B. Farquhar, of York, Pa., is a tool which might seem to be well adapted to French methods and needs. The system of making a number of optional tools, each of which is capable of being attached to a common stock, is familiar to the French in the case of their vineyard implements, though none so varied in their lines of effectiveness as that shown by Farquhar.

The various shares are the bull's tongue, turning shares of various widths and depths, sweep, and scraper.

French turning-moldboard plow.

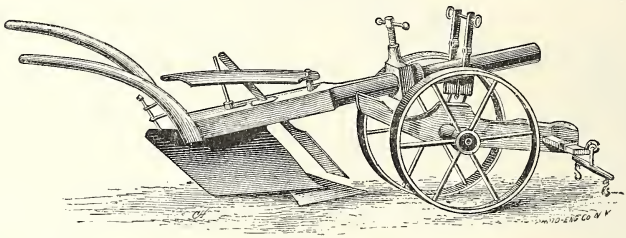


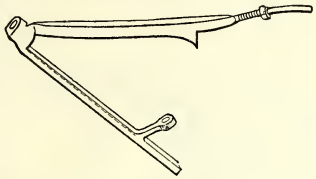
FIG. 20.—*French tourne-oreille (charrue Wasse). Delahaie-Tailleur & Bajac, Liancourt, France.*

2. *Turning-moldboard plows.*

The term *hill-side* plow is generally applied in this country to this description of plow, which, by an adjustment, is capable of turning a furrow to the right or to the left hand;

Plow trials.

the appropriateness of our term consists in its being used by us only for plowing hill-sides which are so steep that the furrow can only be turned down hill. The plow having arrived at the end of its course, turning a furrow to the left, the adjustment of the plow is made to enable it to turn a furrow to the right, and the off horse in returning takes the last-made furrow.



"Wasse" plow with shifting moldboard (Figure 20).

This adjustment is made in at least five different ways, four of which were shown in Paris, in the English, French, or American departments; but not all four in any one. In Britain such a plow is known as the *turn-wrest* plow. The French name for the implement is *tourne-oreille*, *i. e.*, "turning-moldboard."

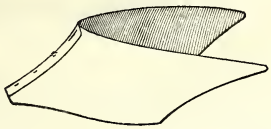
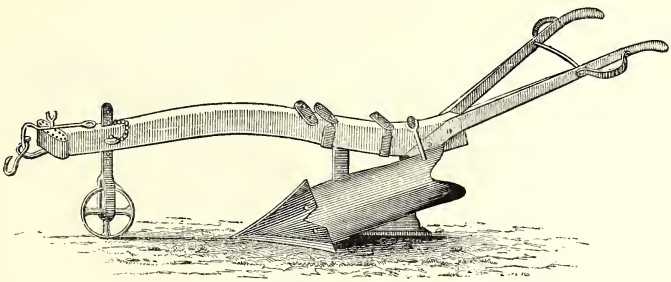


FIG. 21.—*Shifting socket-piece and moldboard of tourne-oreille.*

Various names and systems of operations.

The old Scotch form survives in the French *tourne-oreille*, called the *charrue Wasse*. The sole and share are permanent; the moldboard is both right and left, either being brought into action as may be desired by means of a lever, the other one shifting into the line of draft on the land-side. The same colter serves for either. The plow was exhibited by Delahaie-Tailleur, of Liancourt (*Oise*) (Figures 20, 21).

In the *tourne-oreille* of Meixmoron de Dombasle, of Nancy (*Meurthe-et-Moselle*), the share, moldboard, and land-side are made in one piece (or to move as one), and this is journaled on a horizontal axis at the lower edge. This is unlocked



Meixmoron de Dombasle's turning-moldboard plow.

FIG. 22.—*Tourne-oreille. Meixmoron de Dombasle, Nancy, France.*

and partially rotated at the end of a furrow, converting what was the land-side into a share and sole, and presenting the moldboard in the other direction. The price of this plow is 100 fr.; weighs 98 kilos. This form was also shown in the English section.

Plow trials.

The *tourne-oreille* made by Bruel Frères, of Moulins (*Allier*), is shown in Fig. 23 as a left-hand plow. When it is to be used as a right-hand plow, the two moldboards, which are united on a horizontal axis on the median line, are unlocked, and then turned half around, which brings the one now uppermost to the underneath position, both the moldboards being then presented to the right-hand as they are now to the left. Price of this plow 70 fr.

Bruel Frères' turning moldboard plow.

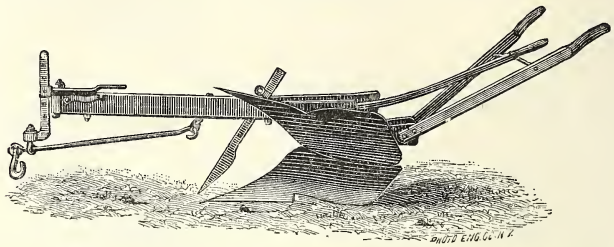


FIG. 23.—*Turning-moldboard plow. Bruel Frères, Moulins, France.*

Another turning-moldboard plow was shown by Alexander Speer & Sons, of Pittsburgh, Pa. It has a right-handed and a left-handed body placed back to back; that is to say, one presented forward and the other rearward. The beam and handles turn on a vertical pivot in the center of the

Speer & Sons' hillside plow.

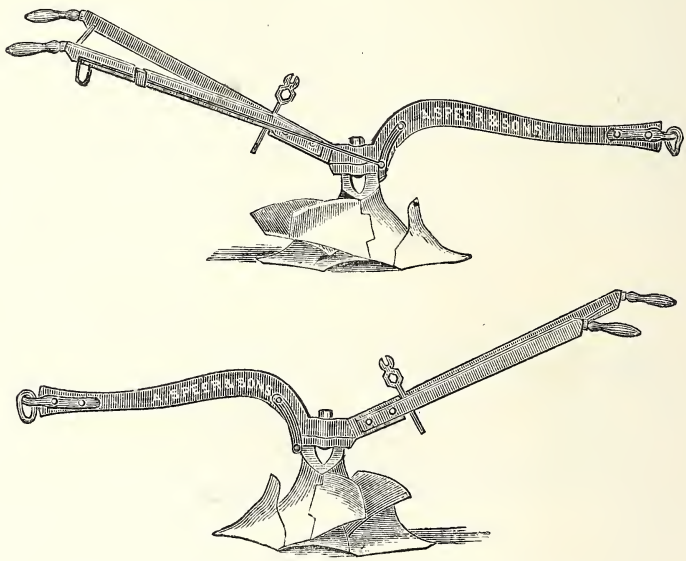


FIG. 24.—*Hillside plow. A. Speer & Sons, Pittsburgh, Pa.*

body, and either the right or left handed portion can be used by turning the beam and handles and presenting them in the appropriate direction. The rear portion of each moldboard is hinged, which allows the one in use to lap over the other,

Plow trials.

which lies back; this avoids the necessity for making the body the sum of the lengths of the two bodies.

An old English turn-wrest plow, known in its day as Hays's, was constructed on the same principle, but without the hinged wings to the moldboards.

Brabant double plow.

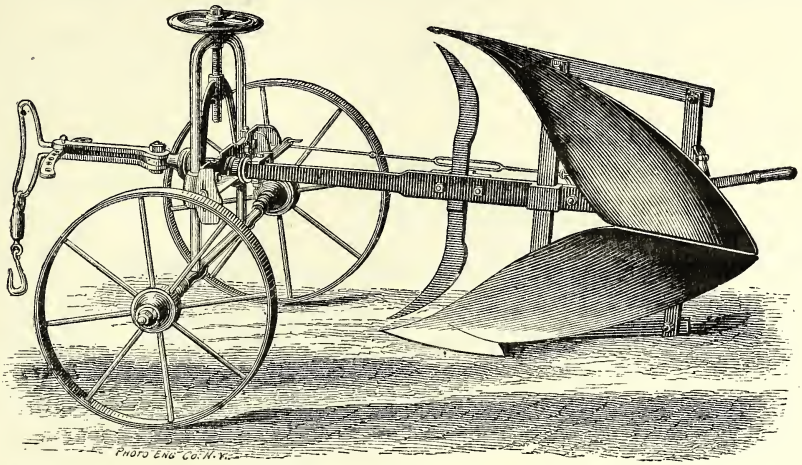


FIG. 25.—*Brabant double plow. C. Gilleux, Segré, France.*

A growing favorite in France.

The most important of the series of turning-moldboard plows is known in France as the *Brabant double.* This plow is meeting with great success, and not on account of its convenience for throwing the soil down hill, but principally, as it would seem, on account of its permitting the plowman to commence at one side of a field and work furrow after furrow clear across it. The English and American practice is to plow in lands; the English lands are generally narrower than with us, as the climate is more moist and the ground more apt to be water-logged.

Brabant double, with skim-colter.

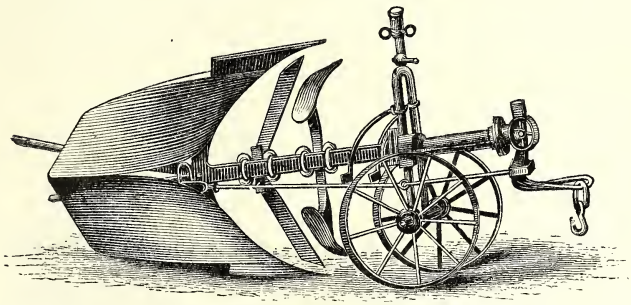


FIG. 26.—*Brabant double, with skim-colter. Delahaie-Tailleur & Bajac, Liancourt, France.*

The Brabant double is made in great variety of structure and sizes, all, however, possessing the feature of having a

Plow trials.

pair of moldboards, one above the other, and either brought into effective position for a right or left hand furrow, respectively. The plow (Fig. 25) was exhibited by M. Guilleux of Segré (*Maine-et-Loire*). His prices are as follows:

Prices of Guilleux's plows (Figure 25).

No. 1, 320 fr., to No. 2, 300 fr., suitable for breaking new ground.
No. 3, 270 fr., to No. 4, 260 fr., suitable for heavy plowing.
No. 5, 250 fr., to No. 6, 240 fr., suitable for ordinary plowing.
No. 7, 220 fr., to No. 8, 200 fr., suitable for light work.
No. 9, 190 fr., suitable for light work.

Brabant double, with subsoil talons.

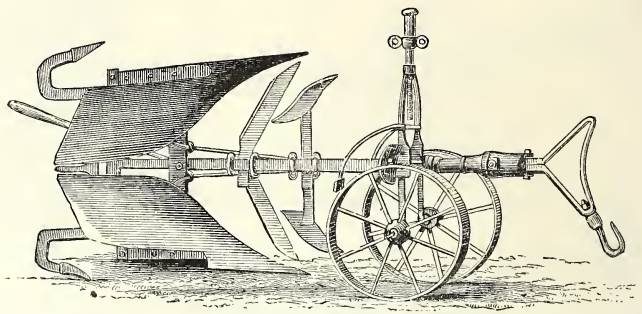


FIG. 27.—*Brabant double, with subsoil talons. Delahaie-Tailleur & Bajac, Liancourt, France.*

They are made of sizes from 1 horse to 16 horses, by Delahaie-Tailleur, of Liancourt (*Oise*), who appears to have been the original constructor in France. The prices are quoted by weight:

Prices of Delahaie - Tailleur's plows (Fig. 26).

75 to 100 kilos	2.00 fr. per kilo.
100 to 130 kilos	1.50 fr. per kilo.
130 to 150 kilos	1.45 fr. per kilo.
150 to 190 kilos	1.40 fr. per kilo.
190 to 280 kilos	1.35 fr. per kilo.
280 to 350 kilos and over	1.30 fr. per kilo.

Brabant double, with skim-share.

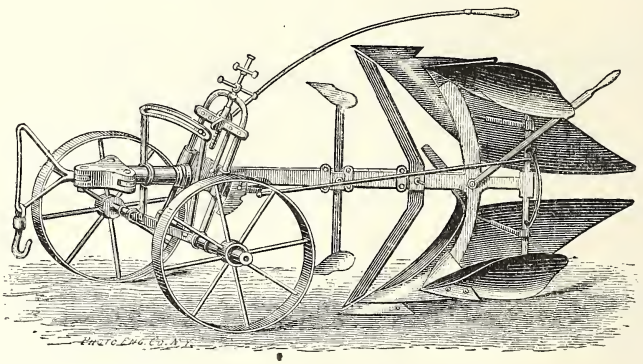


FIG. 28.—*Brabant double, with skim-shares.*

The depth of plowing is regulated by means of a hand-screw on the *avant-train*, which raises or lowers the beam.

Plow trials.

When at the end of a furrow and desiring to return, the plowman leans on the lever which projects at the rear and unlocks the beam, which is free to turn on its axis, making half a revolution and bringing the other plow to the ground changing it from a right to a left hand plow, or *vice versa.* The width of furrow is regulated at the clevis in front, the regulating-screw letting the plow take more or less land. The gage-wheels are of equal diameter, as they are alternately in the furrow.

Mode of using the Brabant double plows.

The deep plowing by the Delahaie-Tailleur, large size Brabant double, is designed to be 0.70 meter land, 0.60 meter depth; drawn by 8 or 10 horses, or 14 to 16 oxen.

Depth of tilth.

The same firm exhibited the Brabant double with claws or talons, which tear up the bottom of the furrow, acting as a subsoil attachment. (Figure 27).

(Figure 27).

Another form of the implement for deep plowing has a skim-share for rolling up the stubble into a little ridge, to be deeply buried by the plow on its next round. These shares are placed in the rear of the principal share and projecting laterally in such a way as to act upon the land not yet touched by the main body of the plow, but preparing the surface ready for the next course.

Brabant double with skim-shares.

(Figures 28, 29).

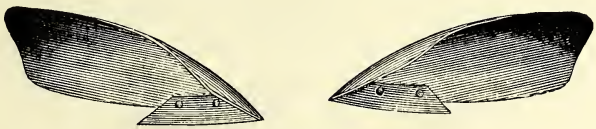


FIG. 29.—*Skim-shares.*

When the skim-share (Fig. 29) is used, the skim-colter—shown as attached in Fig. 28—is detached; the duty of each is the same, and the use optional.

Deep plowing at Petit-Bourg by the Brabant double.

The deepest plowing done at Petit-Bourg was by the Brabant double plows. None other sent to the competitive trials were calculated for so great depth of plowing, for none others were strong enough; we may make an exception in favor of the Italian, which were simply immense, and might have been drawn by elephants. One or more of the Brabant double plows, drawn by 10 oxen, reached a depth of 50 centimeters (19.69″), and when the wire rope of the steam-plow was attached it plowed 21.65″ deep, with a breadth of about 30″. The usual plowing depth is from 0.16 to 0.33 meter, say from 6½″ to 13″. The latter is not commonly attained, but the writer believes it to be much more frequent in France than in the United States, and can name one field in France plowed 20″ deep. This cannot be profitably done without steam-tackle.

Plow trials.

3. *Subsoil plows.*

Subsoil plows.

Subsoil plows were shown in considerable variety. The customary form is one in which the hard-pan at the bottom

Garnier's subsoil plow.

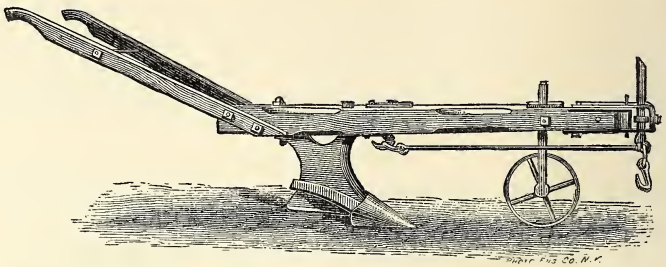


FIG. 30.—*Subsoil-plow. J. M. Garnier, Redon, France.*

of the furrow is broken up and allowed to fall back again—not brought to the surface. It is usually very imprudent to change the natural relative positions of the soil and subsoil, though a portion may be mixed with the soil by plowing a little deeper year after year, within reasonable limits.

Subsoil plowing *vs.* deep plowing.

Garnier's subsoil plow has a share in front and sloping plates at the sides to lift the soil, which then falls back again into the furrow. It has the gage-wheel and clevis arrangements for land and for depth. The price is 45 fr.

Still another form of the Brabant double plow has the

Brabant subsoiler.

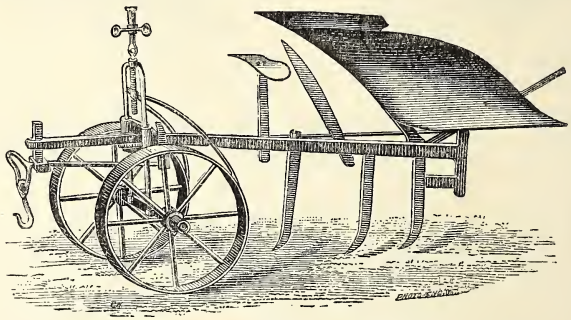


FIG. 31.—*Brabant subsoiler.*

Optional or alternate use of the subsoiler.

skim-plow, colter, and plow on one side of the beam, and scarifier, shares, or tines on the other side; the use of one side or the other is optional or alternate. In the latter case the plow, for ordinary culture, goes to a depth of 15 centimeters, and, the implement being reversed, the bottom of the furrows is torn up an additional 15 centimeters, making a total depth of culture of 0.30 meter.

The subsoil plow (Fig. 32) is also designed to follow in the wake of an ordinary plow, and break up the hard-pan or bottom of the furrow. It is not designed to bring the sub-

soil to the surface, but to open it to allow it to be penetrated by moisture and ameliorated by the air and by manure. The whole frame is of iron, and the lever adjusts the depth of penetration of the shares or withdraws them entirely. The shares are left, middle, and right, and occupy the whole width of the furrow. The weight is 115 kilos, and the price 220 fr. *Plow trials.*

Bodin's subsoiler.

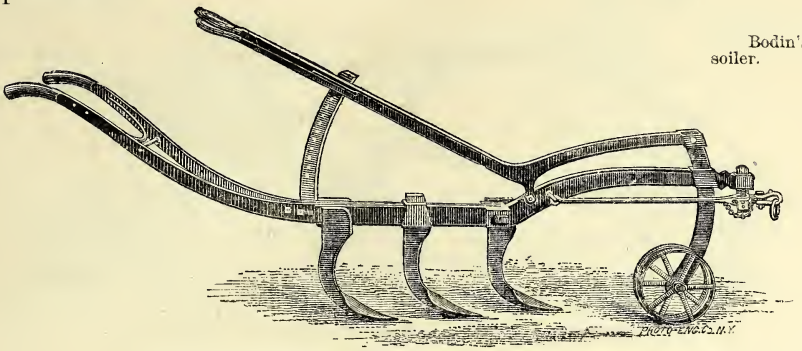


FIG. 32.—*Subsoil plow. E. Bodin, Rennes, France.*

The subsoil plow of Guilleux, of Segré, has the three shares similarly arranged, but, instead of a gage-wheel, it has a runner whose standard is attached by a yoke to the beam. This exact device is used for the same purpose on the crude wooden plows of the Chinese and the Malays of Java, as shown in their respective sections at the Exposi- Guilleux's subsoiler.

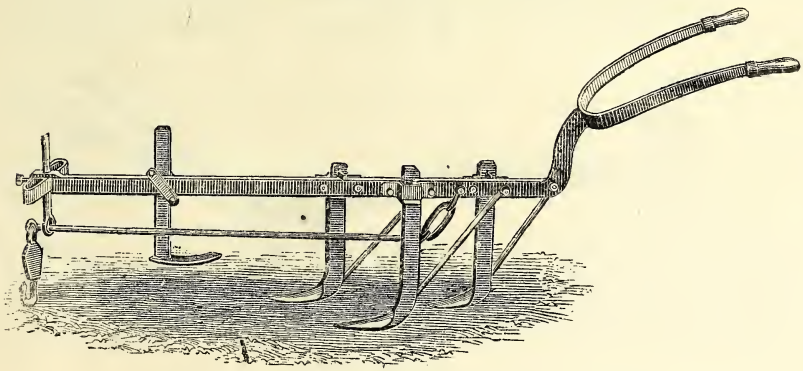


FIG. 33.—*Subsoil plow. C. Guilleux, Segré, France.*

tion. The price of this implement is from 80 to 120 fr., according to size.

The implement shown in Fig. 34 is described as for digging and improving land; presumably wet and compact soils. It was exhibited by Bourdin, of Paris, and is priced at 400 fr. It has a flat, deep standard, a share, a cutting-head, for dividing roots, and several serrated lateral plates, Sayn's scarifier (Figure 34.)

Plow trials.

for cutting roots and making fissures in the soil. The implement has two pairs of wheels, fore and aft, and, by the manipulation of the levers, may be made to ride free of the ground or be set to any depth required, the usual working limit being a depth of 0.6 meter, about 24″. The levers act practically as a parallel motion, and the sole is always horizontal.

Sayn's scarifier.

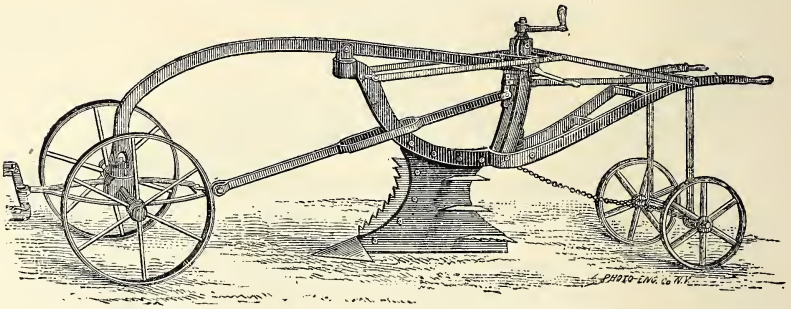


FIG. 34.—*Sayn's scarifier. C. L. Bourdin, Paris.*

Draining plows.

4. *Draining plows.*

Draining plows in France, as elsewhere, are upon either of two principles—to excavate an open drain, or to make an underground passage for the water. The latter is called by us a *mole*-plow, from the round, tunnel-like channel which it makes in the ground. It is termed in France a *charrue sous-sol*, or underground plow and is frequently employed in the track of an ordinary plow as a subsoiler, breaking up

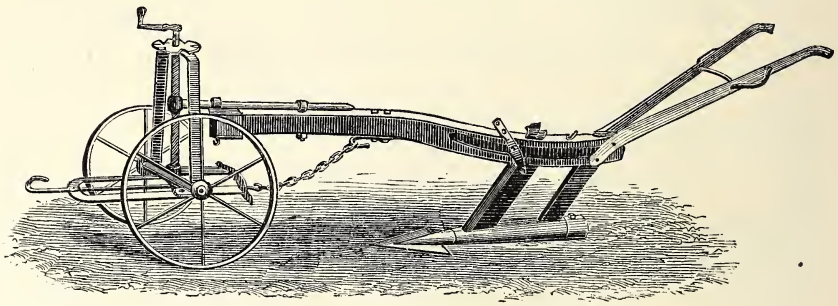


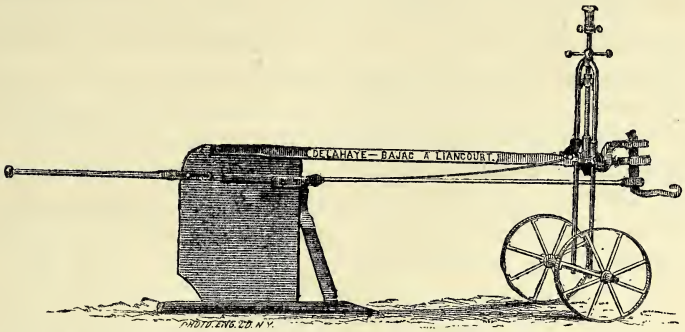
FIG. 35.—*Meixmoron de Dombasle's mole-plow.*

Meixmoron de Dombasle's mole-plow.

the hard-pan forming the bottom of the furrow. The depth of working is usually 30 centimeters below the same depth made by the ordinary plow. The price of the implement is 115 fr., and the weight 98 kilos.

The mole-plow exhibited by Delahaie-Tailleur & Bajac, of Liancourt (*Oise*) has the ordinary French *avant-train* and a plate which form the standard, carrying the long, round

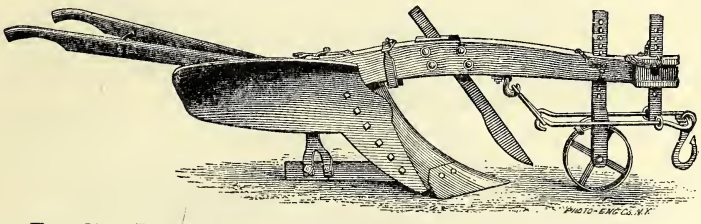
share 9 centimeters in diameter. In its passage through the ground it leaves a conduit of its own diameter for carrying off the water. *Plow trials.*



Mole-plow of Delahaie - Tailleur.

FIG. 36.—*Mole-plow. Delahaie-Tailleur & Bajac, Liancourt, France.*

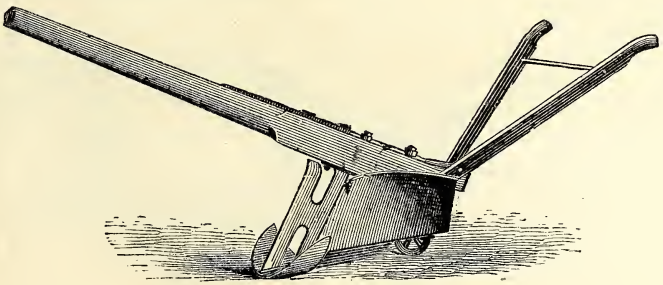
Another class of draining plows is that which follows the track of an ordinary plow and lifts the subsoil to the surface, forming an open drain. In practice the subsoil to a depth of 45 to 55 centimeters is raised, and is thrown out



Draining plow of Meixmoron de Dombasle.

FIG. 37.—*Draining plow. Meixmoron de Dombasle, Nancy, France.*

upon the earth raised by the precedent plow. The lower portion of the plow occupies the first furrow, and the sloping moldboard pushes the soil onto the surface of the ground clear of the edge of the ditch. The price of this plow is 105 fr.; weight, 112 kilos.



Billot's trenching plow.

FIG. 38.—*Billot's trenching plow.*

Billot's trenching plow is intended for cutting drains in natural prairies. The sloping cutter and the curved share cut the sod, which is lifted and thrown in two equal por-

Plow trials.

tions on each side of the ditch. The plow has an ordinary *avant-train*, not shown in the figure.

Randolph's ditching machine.

The large ditching machine of Hon. Theodore F. Randolph, of Morristown, N. J., was exhibited on the same day as the plows, at Petit-Bourg. No land suitable was found on the ground selected for the trials, and the sharp flanges which are intended to imbed themselves in the soil were unable to penetrate the dry clay of the upland where the experiments took place. Its great capacity for work in suitable soil being within the knowledge of one at least of the jury, regret was expressed that no adequate preparation had been made to exhibit it in its proper field.

Ridging plows.

5. *Ridging plows.*

Double moldboard plows (*buttoirs*), for throwing right and left furrows at the same time, are much used in England, and, judging by the display and the ridge system so nearly universal in beet culture, still more common in France.

Guilleux's ridging plow.

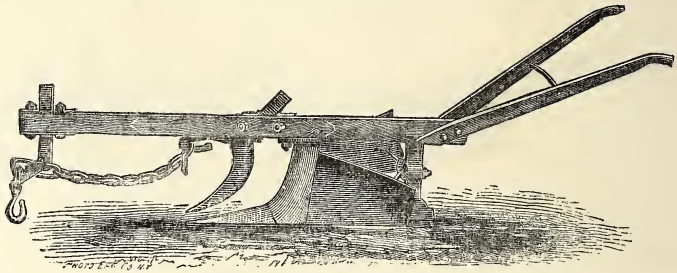


FIG. 39.—*Ridging plow. C. Guilleux, Segré, France.*

They were shown stocked in wood and in iron. Figure 39 is one exhibited by Guilleux, of Segré (*Maine-et-Loire*), and made in three sizes, respectively 40, 50, and 60 fr.

Bodin's double-moldboard plow.

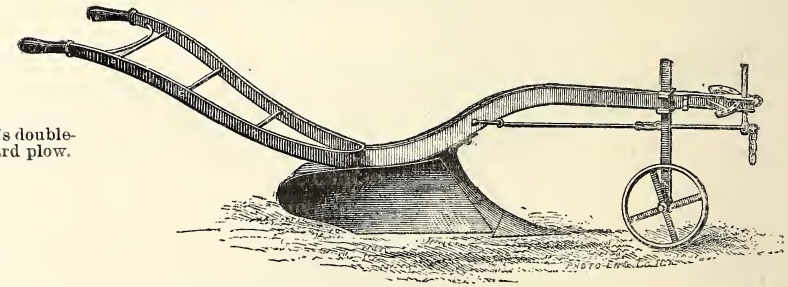


FIG. 40.—*Ridging plow. E. Bodin, Rennes, France.*

The double-moldboard plow made by Bodin, of Trois-Croix, Rennes, is stocked in iron, and when made with one wheel is sold in two sizes, at 110 and 100 fr.; the implements, respectively, weighing 100 and 90 kilos. Made with

two gage-wheels in front, specially adapted to make the ridges on which beet-root seed is sown, the implement costs 10 fr. more. *Plow trials.*

On the same stock may be attached an ordinary plow body or a potato-digger.

6. *Clearing plow.*

Clearing plows.

Of plows especially adapted to clearing in woody or rooty ground but few implements were shown. Incidentally, many of the heavy plows are calculated for such work as it may occur. Others, like our prairie-breakers, are for stubborn sod, wild-grass meadows, and low situations with patches of willow or hazel, brambles or rose bushes, as the case may be. Some statements to this effect have been made in reference to plows previously referred to. See *ante*, *passim*. Delahaie-Tailleur's clearing plow.

The *déboiseuse*, or clearing plow, of Delahaie-Tailleur, is

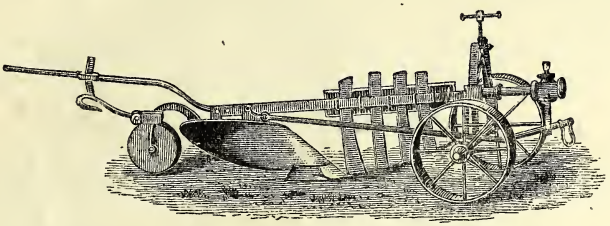


FIG. 41.—*Clearing plow. Delahaie-Tailleur & Bajac, Liancourt, France.*

designed evidently for clearing ground which has grown up in thickets or copses. It is made with 2, 3, 4, 5, or 8 cutters in advance of the plow proper. Each cuts into the land below the preceding one, so that a *déboiseuse* of 5 cutters will divide the roots to an ordinary plow depth.

7. *Sulky-plow.*

Sulky plows.

The sulky or riding plow, which has become so common with us, is a curiosity in Europe. But one was shown in Paris, and it alone of its class was at the Petit-Bourg trials. It was exhibited by Deere & Co., of Moline, Ill., and the quality of the material and the finish of the work were the subjects of general remark. It has the rolling-colter, adjustment for depth and land, and means for withdrawing it from the soil, in turning or traveling, by a single lever. (Fig. 42.) Deere & Co.'s sulky-plow. (Figure 42.)

8. *Gang-plows.*

Gang-plows.

There is a growing tendency in England and France, as well as in the United States, to the use of the gang-plow as

Plow trials.

a saving of the labor of men. Lord Somersville's "double-furrow plow," invented about 1799, had a beam bent for the attachment of two plow bodies, the left-hand one placed laterally and to the rear of the forward one, both being right-handed according to the custom of the country. This was, perhaps, not the first gang-plow, however, for Mr. Duckel, of Esper, in England, had one in 1797, drawn by four horses. These were, however, a little in advance of the times. Now they are popular.

Lord Somerville's double-furrow plow.

Deere & Co.'s sulky-plow.

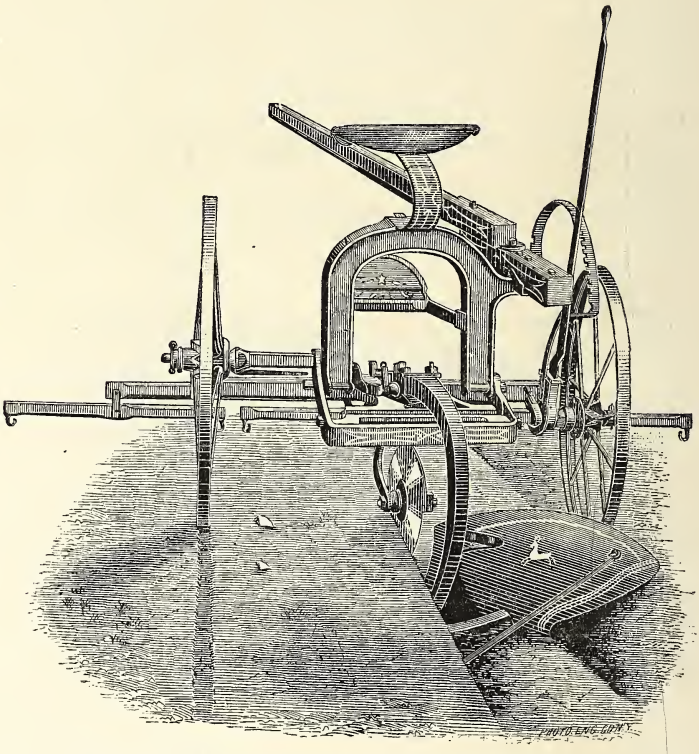


FIG. 42.—*Gilpin sulky-plow. Deere & Co., Moline, Ill.*

Test of the gang-plows at Petit-Bourg.

At Petit-Bourg the gang-plows alone were tested with the dynamometer, and of those shown in the contest two representative implements were chosen for this honor, those of—

Meixmoron de Dombasle.

Meixmoron de Dombasle, of Nancy (*Meurthe-et-Moselle*), France.

Deere & Co.

Deere & Co., of Moline, Ill., United States.

A number of English gang-plows were shown at the Exposition, but not at the competitive trials. The French gang-plows at the trial were numerous.

Plow trials.

The claim made for the French *bisoc* is that it saves in expense of plowing from 15 to 20 fr. per hectare (say $1.20 to $1.60 per acre). It is designed to plow 1½ hectares (say 3.75 acres) per diem. It works with one-third less tractive power than two single plows throwing the same furrow.

Advantages claimed for the *bisoc*.

In the gang-plow trials each implement was required to plow a tract of equal size, the two lots lying alongside of each other and the plows being started simultaneously.

Gang-plow of Meixmoron de Dombasle.

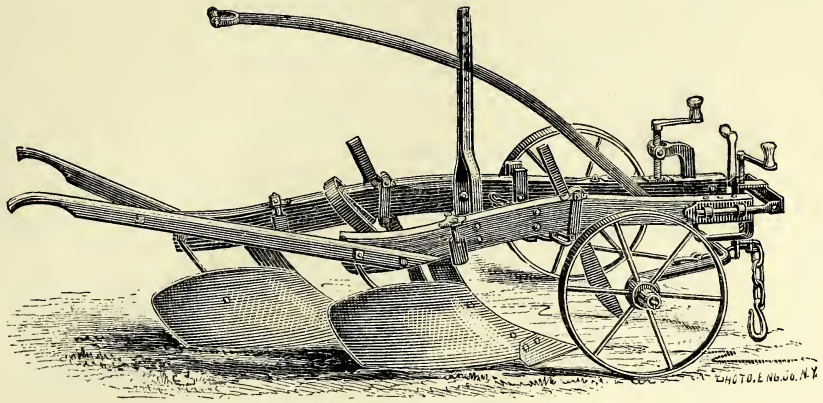


FIG. 43.—*Bisoc. Meixmoron de Dombasle, Nancy, France.*

Each plow was drawn by four horses, and the teams were changed in the middle of the trial. The length of course was 160 meters. The table attached gives the result in a very elaborate manner, and the means of comparing the work done by a given expenditure of power are very ready. The most pregnant column is the eleventh, which gives the mean of two trials of each plow of the power required to displace a metric cube of earth.

Method of testing.

The Meixmoron de Dombasle *bisoc* is made of sizes and prices as follows:

Sizes and prices of the Meixmoron de Dombasle gang-plows.

Size of plow.	Depth of work.	Width of land.	Number of horses required.		Price.	Weight.
			In ordinary land.	In heavy land.		
	Centimeters.	*Centimeters.*			*Francs.*	*Kilos.*
Large *bisoc*	15 to 20	55 to 60	4 to 6	6 to 8	290	247
Medium *bisoc*	11 to 15	40 to 45	3 to 4	.....	240	174
Small *bisoc*	10 to 14	36 to 40	2	.....	175	120
Bisoc subsoiler	.....	.....	.....	.....	335	270

Plow trials.

Dynamometrical table of the trials of gang-plows.

Meixmoron de Dombasle and Deere & Co.

Dynamometric trials of gang-plows at Petit-Bourg (Seine-et-Oise), France, August 6, 1878, under the superintendence of M. Eugène Tisserand, Inspector-General of Agriculture of France, and in connection with the Exposition of 1878.

[The dynamometer used was that belonging to the "Conservatoire des Arts et Métiers," of Paris. Calculations by Professor Tresca *fils*, of the Conservatoire.]

Names of exhibitors of gang-plows.	Trials.*		Surface measure by planimeter.	Length of trace.†	Mean ordinate.‡	Corresponding effort.	Mean depth of furrow.	Mean width of ground plowed at one passage.	Section of land turned.	Power necessary to displace one metric cube of earth.	Mean of two trials.	Length of furrow.	Time of travel.	Weight of plow.
	1. Going.	2. Returning.	*Square millimeters.*	*Meters.*	*Millimeters.*	*Kilogr ammeters.§*	*Millimeters.*	*Millimeters.*	*Square meter.*	*Kilogrammeters.*	*Kilogrammeters.*	*Meters.*	′ ″	*Kilos.*
Meixmoron de Dombasle, of Nancy (*Meurthe-et-Moselle*), France	1	2	115, 160 112, 735	2.430 2.365	49.390 47.670	497.31 500.25	151.4 161.3	678.1 626.0	0.102664 0.100974	4, 644.1 4, 956.2	4, 899.2	160 160	4.80 4.42	247
Deere & Co., of Moline, Ill., United States	1	2	120, 870 125, 970	2.512 2.377	48.120 52.995	504.97 556.13	193.0 167.3	695.6 709.0	0.113383 0.118616	4, 453.7 4, 680.0	4, 566.9	160 160	4.12 4.22	260

1 meter = 39.37079 inches; 1 kilo (kilogram) = 2.2046 pounds avoirdupois; 1 millimeter = 0.0394 inch; 1 hectare (100 ares) = 2.471 acres.

* The ground was slightly inclined. † The base line on the paper ribbon of the dynamometer.

‡ Mean distance between the base and profile lines on paper ribbon.

§ Kilogrammeter, the French dynamic unit. The power required to lift one kilogram to the height of one meter, 1 *cheval-vapeur* (horse-power), is the power required to lift 75 kilos a distance of 1 meter in a second; *i. e.*, 75 kilogrammeters.

Plow trials.

The construction of the Meixmoron de Dombasle *bisoc* is easily understood by the assistance of the engraving (Fig. 43). Speaking in general terms, it consists of two plows of equal size, attached at a regulated distance apart, one a little behind the other, so that its furrow-slice shall not touch the plow in advance, and the two beams attached to a single draft arrangement.

Construction of the Meixmoron de Dombasle gang-plow.

The plow is supported in front upon a pair of wheels whose bent axle is rotatable by means of a lever so as to elevate or depress the front end, and thereby determine the depth to which the shares shall penetrate. The lever moves in a vertical slotted guide, and a pin above the lever, passing through holes in the guide, maintains the plow at the required adjustment. It is necessary, also, to adjust the draft-chain at the clevis to raise the point of traction for deep plowing and depress it for shallow. The test of adjustment is when the shares penetrate to the right depth with a very light pressure upon the wheels, so that they leave but a faint trace of their passage.

The furrow is equalized between the two plows by means of turning in one or the other direction the screw placed on the long beam. In plowing the last furrow of a field, when but a single furrow remains, the horizontal screw is turned to the left, so that the right-hand plow runs in the preceding furrow.

Deere & Co.'s gang-plow.

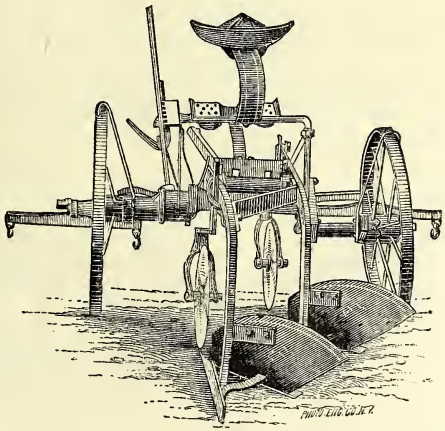


FIG. 44.—*Gang-plow. Deere & Co., Moline, Ill.*

These plows are made strong enough for 8 or 10 horses for extra-deep plowing or breaking new ground.

The Deere gang-plow is a more compact arrangement, and is a riding plow. This latter feature is a novelty in Europe.

While the implement of Meixmoron de Dombasle consists

Plow trials.

of two plows with gage-wheels in front, and drawn by means of a single broad clevis, to which the noses of the plows are attached, the Deere plow follows the American "sulky"

Construction of the Deere & Co. gang-plow.

system, a wheeled carriage, which has a tongue for the horses, a seat for the driver, and a point of attachment for the plows, which are braced and adjusted permanently for relative distance, and controlled by a single lever, which regulates the depth or withdraws the plows from the ground. It opens up the first furrow and finishes the land by moving the lever from one notch to another, the plows maintaining a level position at all depths; and, by pressing the same lever outward until it locks into a lug on the hub, the plows are carried clear of the ground by a half revolution of the wheel.

It is all of iron and steel.

Riding the plow.

As to the general question of the economy of carrying the driver, it is contended that the method of carrying the weight of the plow and furrow-slice on wheels more than counterbalances the addition to the draft due to the weight of the driver.

Rolling-colter.

While questions of corn cultivation do not much concern the French farmer, it is nevertheless a very important service performed by the sharp rolling-colters in cutting the corn stalks of the previous season in advance of the plowshare.

The *charrue bisoc* exhibited by Bodin, of Trois-Croix, Rennes, has two plow bodies, with long moldboards, with two unequal wheels, one to run in the furrow and the other on the land. The plows are right-handed, as seems universal in Europe, and the rear plow alone has stilts for the

Bodin's double plow.

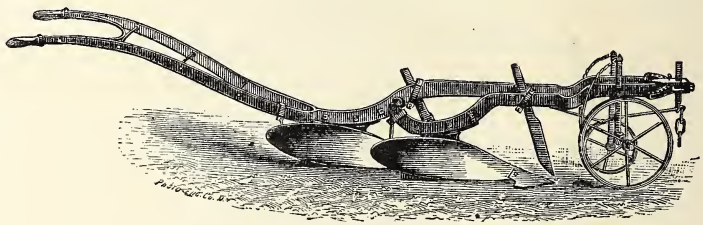
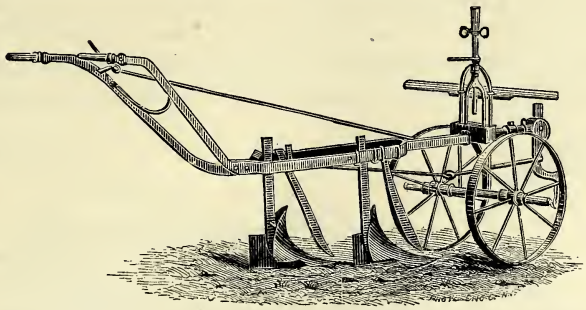


FIG. 45.—*Bisoc. E. Bodin, Rennes, France.*

plowman, the beam of the forward plow being rigged out from the longer beam of the other plow. The wrought-iron frame is very well constructed. It is intended, according to the nature of the ground, for 3 horses or 4 oxen, with ordinarily light land.

The price is 200 fr., and the weight 120 kilos.

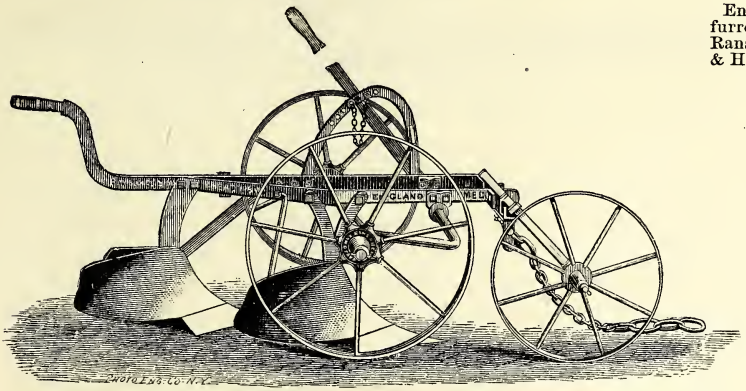
The *bisoc* of Delahaie-Tailleur & Bajac, of Liancourt (*Oise*), has a very different style of frame, and the *avant-train* on the model of the Brabant pattern, made in such very extensive variety of style and size by this firm. *Plow trials.*



Delahaie-Tailleur's two-furrow plow.

FIG. 46.—*Bisoc. Delahaie-Tailleur & Bajac, Liancourt, France.*

The English implement-makers exhibited a number of gang-plows, double and triple, but did not bring them to the trials at Petit-Bourg. It may be as well, however, to show these implements to afford means of comparison, as they do not lose all interest in consequence of the want of enterprise of their owners or agents.



English double-furrow plow. Ransomes, Sims, & Head.

FIG. 47. *Double-furrow plow. Ransomes, Sims, & Head, Ipswich, England.*

Ransomes, Sims, & Head, of Ipswich, England, exhibited double-furrow plows of two varieties, one in which the weight is thrown upon three wheels, the depth regulated by a lever which governs the side wheels and a gage-wheel adjustment in front; the other style, in which the implement consists of a pair of plows yoked together. Each has a gage-wheel for depth. Gang-plows of two kinds. (Figures 47, 48).

Fig. 47 shows the first-mentioned kind, which has a quadrilateral frame supported on a bent axle under the control

Plow trials.

of a lever, whose position at any adjustment is maintained by a set-pin in a quadrant-bar.

The price is quoted at 315 fr., or the English equivalent.

Ransomes, Sims, & Head.

The other plow is shown in Fig. 48 in two positions, one the working position, the other turning. In the latter the

Twin-body gang-plow.

plow is thrown over to the left so as to rest upon the hemispherical land-wheel and a stirrup at the near side of the beam, which acts as a runner on which the plow drags

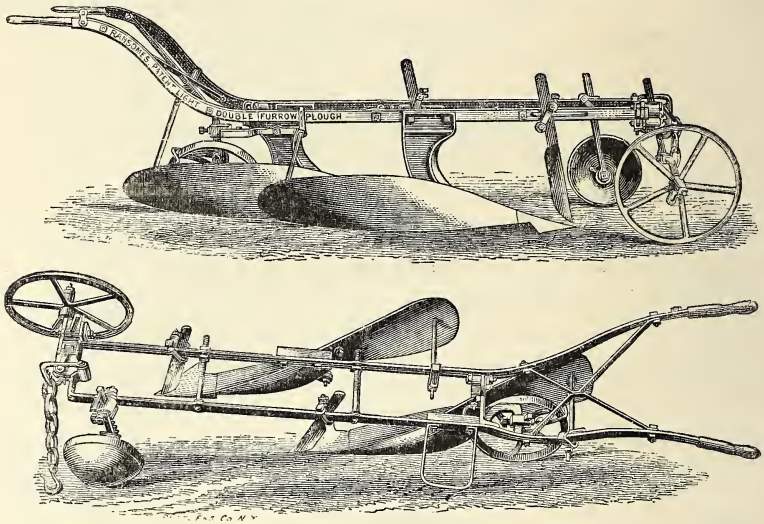


FIG. 48.—*Double-furrow plow. Ransomes, Sims, & Head, Ipswich, England.*

These plows have beams adjustable or fixed as to relative distance, as may be required. With fixed beams two furrows are turned, each 23 centimeters wide and 8 to 20 centimeters deep, as may be determined by the clevis and gage-wheel adjustments. With adjustable beams the width of furrows is regulated at from 18 to 27 centimeters and depth 5 to 20 centimeters.

French *bisoc double.*

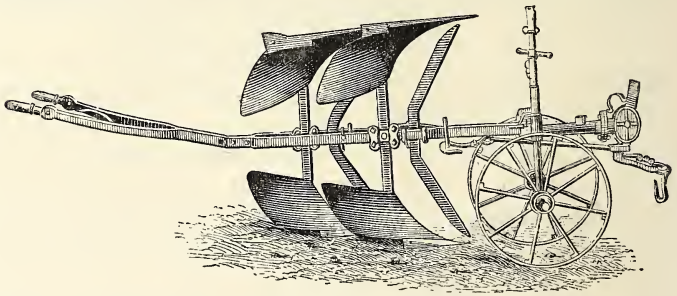


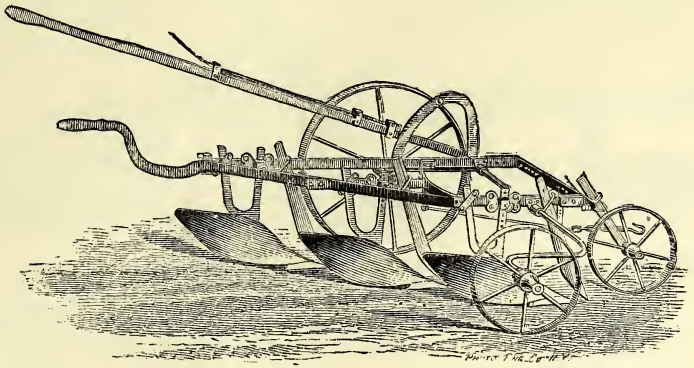
FIG. 49.—*Bisoc double. Delahaie-Tailleur & Bajac, Liancourt, France.*

A furrow-wheel running behind the rear plow, in the angle of the furrow, is an aid in regulating depth and is a

substitute for a long sole. It is a feature used in England as far back as 1819. *Plow trials.*

The weight is 114 kilos; price, 240 fr.

The Brabant double is also rigged as a *bisoc*. The example shown was by the firm of Delahaie-Tailleur. It has the same adjustments for depth and for land, and the same method of inverting the plow body in order to convert it from a right to a left hand plow, and *vise versa*. (Fig. 49). *Bisoc double.* (Figure 49).

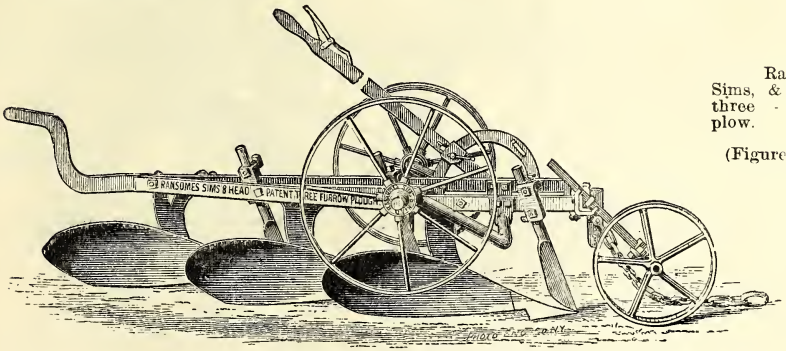


Delahaie-Tailleur's three-plow gang.

FIG. 50.—*Charrue à trois socs. Delahaie-Tailleur & Bajac, Liancourt, France.*

The same firm exhibited the three-plow gang, which has a triangular frame and a third or supplementary wheel for lifting the plow frame and causing the plows to slip up out of the ground as the team advances. This is the position in which the implement is shown.

The price is 350 fr.



Ransomes, Sims, & Head's three-furrow plow.

(Figures 51, 52.)

FIG. 51.—*Three-furrow plow (position at work). Ransomes, Sims, & Head, Ipswich, England.*

Ransomes, Sims, & Head's three-furrow plow has the same general appearance. The two engravings (Figs. 51 and 52) require but little explanation. With the first round the three furrows will not be of quite equal depth, but when

Plow trials.

a leading furrow is opened and the gage-wheel in the furrow set to the required depth, the work is regular, the depth being determined by the set of the three wheels, the one in front and the two at the sides, the latter regulated by the lever and quadrant.

English three-furrow plows.

Hornsby showed admirable examples of multifurrow plows, as did also Corbett & Peale, but the list need not be prolonged. Deere & Co., of Moline, Ill., did not exhibit their triple gang-plow.

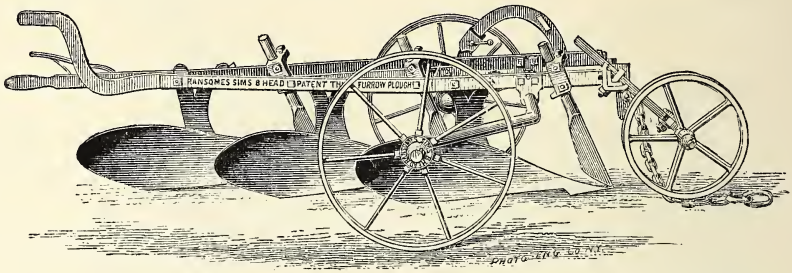


FIG. 52.—*Three-furrow plow (position out of the ground, in turning). Ransomes, Sims & Head, Ipswich, England.*

An implement with five plows was exhibited by Delahaie-Tailleur & Bajac, designed for leveling ridges made in the beet or potato culture, and to leave the ground flat for sowing in wheat or to clover, The shares are thrown into or

Delahaie-Tailleur's leveling plow.

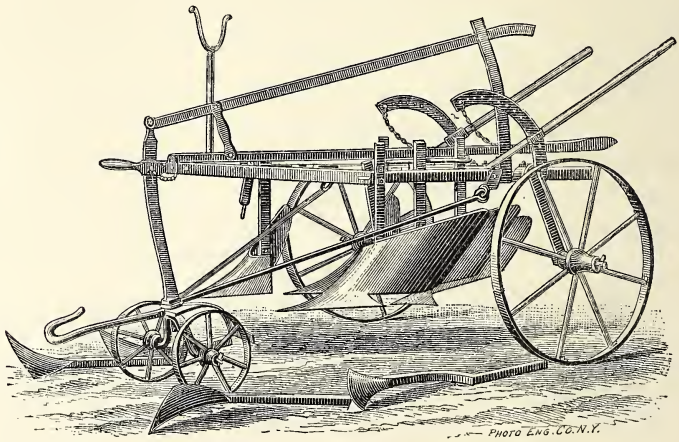


FIG. 53.—*Leveling implement with five plows. Delahaie-Tailleur & Bajac, Liancourt, France.*

out of the soil by a single lever, and their working depth is regulated by the two rear levers, which actuate the bent axles of the hind wheels so that the plows may be let into the ground any required depth, or, as in the engraving,

lifted entirely clear of the soil for traveling from place to place. *Plow trials.*

The extent of ridge culture in France makes such an implement desirable there, and the introduction of beet culture into the United States may give it some value with us, to plow down the ridges preparatory to replowing, or level the soil for other crops for which flat culture alone is suitable, as for those which are cut by the reaper or mower. Use of the leveling plow in beet culture.

The implement straddles a ridge from 0.90 to 1.50 meter in width and the forward plows remove a slice from each side, each of the next pair of plows pares off another slice, and the fifth or middle plow splits the remainder, throwing it equally to each side.

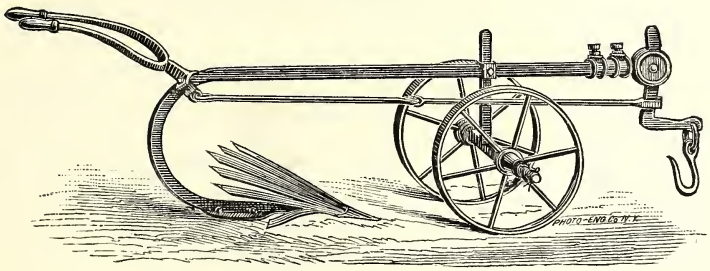
The implement is also used for plowing-in wheat. It weighs 250 kilos.

9. *Root-diggers.* Root-diggers.

Consistently with the importance of the root crops in the agriculture of France, the machines for digging potatoes or pulling beets were shown in considerable numbers and variety. The potato-diggers affect a larger area of country, but the beet cultivation is in the hands of the most advanced agriculturists, who can appreciate and purchase special tools for the time when work is most laborious and pressing. Speaking for the north and middle of France, it may be said that while the operations in the beet-root sugar and alcohol factories may extend for a period of three months, the roots must be pulled in a few weeks, and those not worked at once stored in pits or *silos*. Potato-diggers. Beet-pullers. Importance of the beet culture in Europe.

Potato-diggers were shown by three nations—France, England, and the United States.

The French implements generally follow one type, but are single or double acting—*simple et double effet*. French potato-diggers.



Single share.

FIG. 54.—*Potato-digger* (*simple effet*).

Fig. 54 has a share with fingers trailing upward and backward; it lifts the earth and the tubers, and the friable soil

Plow trials.

falling between the bars leaves the tubers to fall over the rear of the grid or through the larger interstices, so as to lie above the soil, to be readily seen and gathered by those who follow to pick them up.

French potato-digger, two shares.

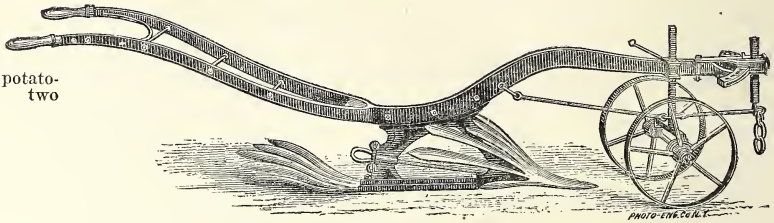


FIG. 55.—*Potato-digger (double effet).*

The *arracheur de pommes de terre, double effet*, Fig. 55, has a second grid which repeats and completes the operation.

English potato-digger, Penney & Co.

Penney & Co., of Lincoln, England, exhibited a potato-digger drawn by two horses. The share roots out the tubers and a revolving disk with forks throws them against a grating which prevents their being scattered.

By means of a lever the machine is raised or lowered or the movement of the forks entirely stopped. The work performed is three to four acres per day.

The price is £15.

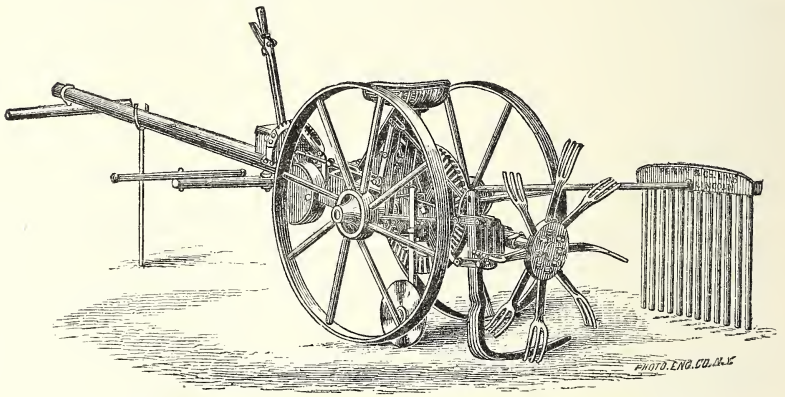


FIG. 56.—*Potato-digger. Penney & Co., Lincoln, England.*

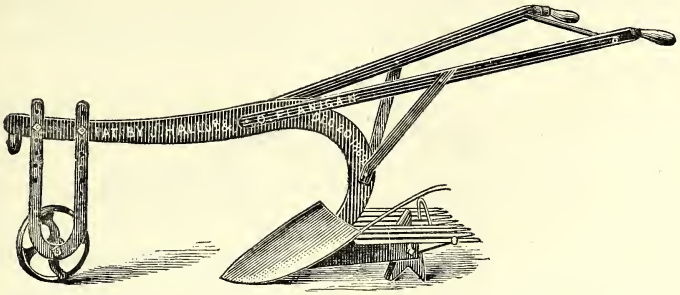
American potato digger, Speer & Sons. (Figure 57.)

One American potato-digger was shown in the exhibit of Alexander Speer & Sons, of Pittsburgh, Pa. It is operated by one person and two horses. The share lifts the earth and tubers and they fall together on to the hinged grid, which is lifted up and down by a star-wheel which comes in contact with the ground beneath the grid.

Price, $20.

The culture of the beet, which is so widespread and important in France, Belgium, Germany, and Austria, has suggested quite a large number of special implements—plows

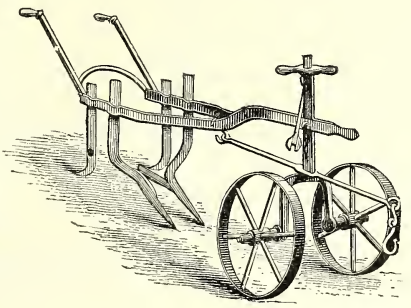
which turn up the soil to a depth of 15″; subsoilers which pulverize a farther depth of 6″ on the bottom of the first *Plow trials.*



Speer & Sons' potato-digger.

FIG. 57.—*Potato-digger. Alexander Speer & Sons, Pittsburgh, Pa.*

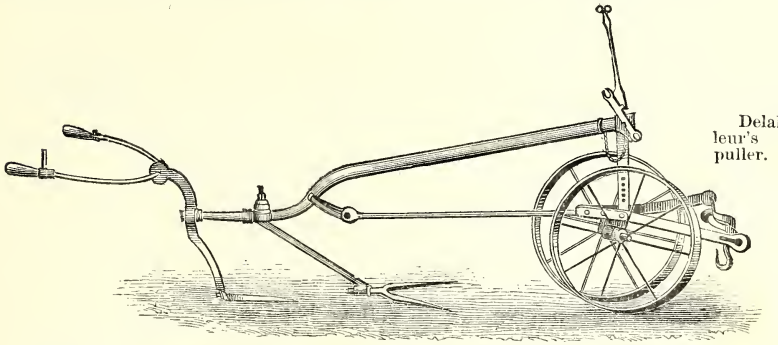
furrow; light plows for throwing the soil alternately to and from the plants in the process of tending the crop; double-moldboard plows for throwing the earth against both rows while passing once down the balk; machines for tearing the roots out of the ground and leaving them on the surface to be picked up; narrow-gage portable tracks and small wagons drawn by horses, passing through or around the fields and thence to the factory where sugar is made or alcohol distilled. Variety of machines used in beet culture.



Beet-root puller.

FIG. 58.—*Beet-puller.*

The beet-puller, *arracheur de betteraves*, generally consists of a sort of fork, slanting downward so as to include the root between its prongs and lift it upward and



Delahaie-Tailleur's beet root puller.

FIG. 59.—*Beet-root puller. Delahaie-Tailleur & Bajac, Liancourt, France.*

forward. It injures the beet to bruise it or to break the tap-root, as it bleeds and wastes the sweet juice. Following the fork are prongs which lift the roots clear of the earth with

Plow trials.

which they are more or less enveloped as they are dragged out of the ground.

Fig. 59 shows another form of the same kind of implement. It is made in three sizes, at a cost of from 170 to 200 fr.

Optional attachments for beets or potatoes.

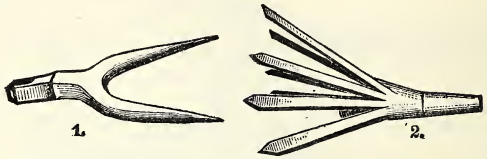


FIG. 60.—1. *Fork of beet-puller.* 2. *Share of potato-digger.*

Fig. 60 shows substitute attachments by which the same implement may be made to dig beets or potatoes. It was exhibited by Delahaie-Tailleur & Bajac, of Liancourt (*Oise*). The same firm shows two other forms of implement, Figures 61, 62, for the same purpose. The latter one has a pre-

Beet-root puller.

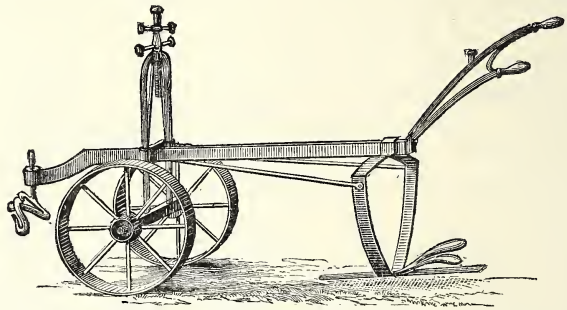


FIG. 61.—*Beet-root puller. Delahaie-Tailleur & Bajac, Liancourt, France.*

cedent portion (*coupe collet*) for cutting off the leaves of the beets simultaneously with the pulling of the roots. Several forms of interchangeable shares are furnished with the implement, *i. e.*, shares without branches, or with two

Beet-root puller, with leaf-cutter.

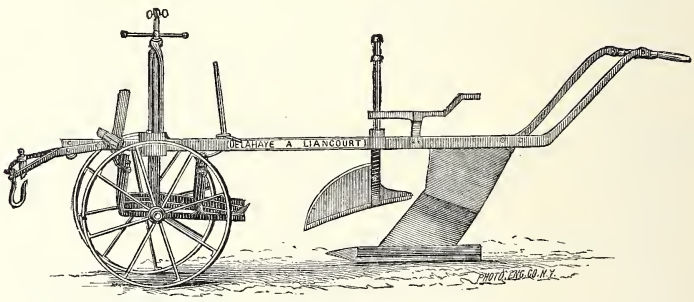


FIG. 62.—*Beet-root digger. Delahaie-Tailleur & Bajac, Liancourt, France.*

or with three branches, according to the kind of beet and the nature of the soil. The work performed is 1 hectare (about 2½ acres) per diem.

STEAM PLOWS AND CULTIVATORS.

Steam plows and cultivators.

Official trials at Petit-Bourg and Gonesse, July and August, 1878.

The official trials of steam plows and cultivators came off at Petit-Bourg, in the department of the *Seine-et Marne*, the 29th of July, and at Gonesse, in the department of the *Seine-et-Oise*, August 12, 1878. Field trials.

At the former were several of the double-engine steam-tackles of Fowler & Sons, of Leeds, England, and one set on the roundabout system, by Debains, of Saint-Remy-Claire-fontaine, near Ramboillet (*Seine-et-Oise*), France. Fowler & Sons. Debains.

Several of the Aveling & Porter tackles, made at Rochester, England, were shown at Gonesse, both plowing and cultivating. Aveling & Porter.

The following paper treats of several other forms and modifications, both of engines and methods, for the time is probably near at hand for the adoption of steam culture in many parts of our country. At present we are behind England, Scotland, Egypt, Austria, Hungary, France, Russia, Italy, Germany, India, West Indies, Turkey, Algiers, Australia, Spain, Demerara, and Peru. Our backward position in steam culture.

The list might be extended, but perhaps that will do for the present. It is to be hoped that the list may be made up with a different exhibit before many years have passed.

It is quite certain that first-class cultivation of the ground is impracticable in many soils without steam-power. This was practically settled in the minds of the most enlightened British agriculturists when the Royal Agricultural Society of England awarded a prize of £500 to Fowler in 1858, an example followed by the Highland Society of Scotland. Since this time the march has been almost continually onward, and at the present time more than 3,000 steam-plowing engines are employed in England and Scotland; more than 400 tackles, almost all employing two engines each, have been sent to Egypt in the last 15 years; several hundred are employed in Germany, Austria, and Hungary in the cultivation of beet-root; and hundreds more in the various countries cited above. Necessity of steam machinery for perfect cultivation. Prize of the Royal Agric. Soc. of England in 1858. Highland Soc. of Scotland. Rapid increase in the use of steam plows.

The steam-plow is as necessary an adjunct in its own sphere as the locomotive in the grand system of inland transportation or the steam-vessel at sea. The railway

Steam culture.

train has not banished the wagon, barouche, and buggy, nor will the steam-plow supersede entirely the plow and cultivator worked by horse-power. The course is, however, onward, and we are lagging behind Africa.

Intensive culture.

Intensive culture.

When, by the use of steam cultivation, farming becomes more like a commercial enterprise, capital will flow to agriculture, the best class of machinery will be employed for every operation, labor will be reduced to a minimum, and

Future prospects.

the combined pleasures and profits of farming will attract to it men of science and enterprise.

The education of a thorough farmer.

The education of a young farmer for a business which requires so much sound practical judgment in all its details should be of the most varied description. He should be trained to observe the varying conditions of the soil so as to conduct the operations which are expedient under the varying circumstances. He should be a good mechanic, and able to judge practically of where and why a thing fails, and have judgment to alter things to suit, and should make himself acquainted with the mechanical and chemical principles involved in the working of the machines, and the composition of the soil and the products derived therefrom.

The demonstrated advantages of steam culture.

Five propositions may be insisted upon, as having been demonstrated:

1. For the hard work of a farm steam is cheaper than animal power.

2. Deeper and more efficient cultivation is obtained than is practicable with horse-power.

3. The operation of plowing may be performed with greater rapidity and at the best seasons of the year, and under circumstances unfavorable for horse-work.

4. The hard-pan being once broken and made open for drainage and aëration, is not closed again by tramping.

5. Horses are free for other work when the most favorable season for plowing occurs.

Estimates.

Estimates.

The estimates of the economic question—steam plowing *versus* horse-plowing—have been made on many occasions and in various countries.

Scottish Steam Cultivation Company of Edinburgh.

The following is an estimate made by the secretary of the Scottish Steam Cultivation Company of Edinburgh, in 1871, a company which owns the engines and tackle, and plows for farmers at a stated price per acre and of a determinate depth.

Steam culture. Scottish Steam Cultivation Company of Edinburgh.

The company has 12 stations in Scotland; at each of 11 stations it has Fowler's complete 12-horse-power double set of cultivating tackle, and at one station Fowler's 14-horse-power double set.

Estimates for plowing 100 acres.

	£.	s.	d.
Charge by the company for plowing 100 acres 8″ deep, at 10*s.* 6*d.* per acre	52	10	0

To cultivate this by horses he requires—

Compared with horse work.

	£.	s.	d.
2 pairs of horses, at a cost of £160.			
Interest on which is	8	0	0
Wear and tear, 15 per cent. on cost	24	0	0
Harness for 4 horses, £10.			
Interest, wear, tear	2	10	0
2 plows, £10.			
Interest, wear, tear	2	10	0
2 plowmen's wages	80	0	0
4 horses' food	100	0	0
Smithing for 4 horses	10	0	0
Yearly expense	227	0	0
Working days, 300 in the year; plowing, 100 days—one-third of the above, equal to	75	13	4
Saving	23	3	4
To which add for the fair proportion of broken time of men and horses	20	0	0
	43	3	4
And deduct for fuel for the locomotives	10	0	0

Net result

	£.	s.	d.
Net saving of steam over horses on 100 acres arable land	33	3	4

Tariff of charges for plowing and cultivating.

The company's tariff of charges per acre is as follows:

	s.	d.
Plowing stubble not exceeding 8″	10	6
Plowing stubble not exceeding 10″	12	0
Plowing stubble not exceeding 12″	14	0
Cultivating not exceeding 10″	9	6
Cultivating not exceeding 12″	12	0
Cultivating land broken by the company's tackle in the preceding autumn, 12″	10	6
Cultivating the second time over, 2*s.* 6*d.* less than the first time.		
Harrowing once	2	6
Harrowing twice	4	0

Conditions.

Conditions.—The employer finds coal and water, the company providing water-cart and suction-pipe. The employer fills the engine-bunker with fuel and the boiler with water on leaving; supplies rope-porter boys if necessary; sends the water-cart on to the next station.

Terms.

Terms.—Cash on completion of job.

Steam culture. In Algiers.

The steam-plow in Algiers.

M. Eugène Tisserand. M. Eugène Tisserand, the Inspector-General of Agriculture of France, has favored the writer with a statement of the cost of working a Fowler 16-horse-power double-engine tackle in Algiers.

Parching climate of Africa. The useful effect is particularly remarkable in a land where the soil cultivated by the ordinary plow is hard and dry as a road from April to October, but with the deep steam-cultivation remains friable, and a crop which requires summer plowing is rendered possible. The actual product of the land is doubled at once.

A deep steam cultivation is considered by M. Tisserand as the equivalent of half an irrigation. The ground is a sort

Peculiar benefit of deep culture in Algiers. of sponge, and absorbs the heavy dews to such an extent that it withstands the parching sun, and each night renews the moisture, while the shallow-plowed soil is effectually dried early in the season and is obdurate thereafter until the fall rains.

Estimate of expenses of steam culture in Algiers per annum. The following statement gives the experience with a Fowler double-engine set of tackle of 16-horse power for a period of one year. Expenses of labor, fuel, etc., will vary in different countries, but these are furnished without other comment, as experts can make the allowances:

		Francs.
Workmen.	*Personnel of the machines.*	
	1 mechanic, 1,591 hours of work, at 1.20 fr. per hour	1,925.00
	2 firemen, 1,756 × 2 = 3,512 hours of work, at 1.02 fr. per man per hour	3,600.00
		5,525.00
	Steam-engines.	
	2 engines of 16-horse power each.	
Fuel, &c.	Fuel, etc.:	
	125,491 kilos coal, at 50 to 60 fr. per *tonne* (1,000 kilos)	6,349.24
	794 kilos oil, at 1.10 fr	873.40
	60,658 kilos wood, at 1.18 fr	514.00
	Rags, grease, resin, etc	313.65
		8,050.29
Repairs.	Repairs	936.00
	Miscellaneous assistance.	
Laborers and hauling.	1,621 hours' work of hired men	551.00
	104 hours' work of horses, hauling wood, coal, etc	32.15
	424 hours' work of oxen	21.20
		604.35

Grand total of expenses. — *Steam culture.*

	Francs.	
Personnel	5,525.00	Total expense of steam culture in Algiers per annum.
Fuel, etc., engines	8,050.29	
Repairs	936.00	
Miscellaneous	604.35	
	15,115.64	

Product in hours of effective work	hours	1,756	Product in hours.
Total cost per hour of effective work, 2 engines	francs	8.61	Cost per hour.

Work. — Work.

1. Expense of steam, working 1 hectare (=2.471 acres) of the ordinary soil of Algeria to a depth of from 32 to 35 centimeters (=13″ to 14″): — Expenses per hectare with steam plow.

	Hours.	Francs.
Labor of steam-plow	4.10	50.25
Labor of engineer	4.10	4.92
Labor of 2 firemen	8.20	8.36
Labor of horses	8.50	2.73
Labor of drivers	8.50	2.89
		69.15

2. Plowing with oxen and men to an equal depth would cost per hectare ..... francs .. 120.00 — With men and oxen.

3. Expense of working steam-scarifier, a light 7-tine cultivator, per hectare: — Expenses per hectare with steam cultivator.

	Hours.	Francs.
Steam-plow	2.12	23.91
Engineer	2.12	2.55
2 firemen	4.24	4.32
Horses	4.24	1.36
2 drivers	4.24	1.47
		33.61

4. Shallow plowing with oxen, corresponding to depth of No. 3: — With men and oxen.

	Hours.	Francs.
Laborers	15.70 @ 0.34	5.54
Oxen	136.80 @ 0.05	6.85
Workmen		5.95
		18.33

5. Expense of harrowing and seeding with animals, per hectare: — Expenses of harrowing and seeding per hectare with men and animals.

	Hours.	Francs.
Laborer	2.80	0.95
Horses	1.30	0.40
Oxen	23.30	1.16
Mule	0.30	0.06
Workmen		0.78
		3.35

Steam culture.

Expenses of harrowing with men and oxen per hectare.

6. Harrowing with men and oxen, per hectare:

	Hours.	Francs.
Laborer	1.70	0.58
Oxen	5.00	0.25
Workmen		0.52
		1.35

Expense of steam plowing, 60 centimeters depth.

7. Expense of steam-plowing, 60 centimeters depth:

1 hectare in 10 hours, cost per hour 8.61 fr.....francs.. 86.10

Impracticable with animals.

NOTE.—The time is given in hours and centimeters (one-hundredth of an hour).

The wages of men, 0.34 fr. = 7 cents.

The hour's work of an ox, 0.05 fr. = 1 cent.

Algiers as affording an opportunity of comparison.

Algiers affords an opportunity of making a comparison. In the first place, with the French love of figures and administration, the accounts are kept with rigid exactness and particularity. The writer had access to the original accounts.

Dear fuel.

Coal and wood are very high in Algiers—coal, $8 to $10 per ton of 2,000 lbs.

Cheap labor.

Wages are very low among the Kabyle Arabs—68 cents per day of 10 hours, without board.

Hire of ox per day of 10 hours, 10 cents. The animals pasture on the abundant natural grass of the country.

Result in Algiers.

Under these circumstances of relative prices, the common plow is the cheaper for shallow work and the steam-plow for deep cultivation.

Where coal is cheap and labor is dear, both these differences will be in favor of steam and bring a still larger area within its scope.

The price of the steam-tackle used in Algiers was 70,000 fr. The interest of the money invested is not included in the above.

Quantity of work performed by steam compared with horse work.

As to quantity of work, it may be said that the breadth of land plowed at one bout by a 12-horse-power double-engine tackle is about equal to that of 12 horses in 6 plows at one round each, and the speed of the steam-plows is about double. The day's work, therefore, is equal to that of 24 horses. The steam-plow alimentation is only while at work. On idle days and in bad weather it requires only shelter and is fortunate if it gets that.

Deep cultivation.

Deep cultivation.

Deep cultivation increases the arable bulk with the same area, and is an absolute addition to the productive power as much as if additional area were acquired.

Any farmer can tell his arable area. How many their

arable depth? If a plant can find depth it will not require so much breadth. A plant struggling for existence in a shallow soil seeks a broad area and kills off or dwarfs its neighbors; it is struggle for existence. The same inches of area under deep culture will afford nourishment for many more plants than the shallow culture, and of a more permanent character, less subject to casualties of drought or excess of moisture. *Steam culture.* Advantages of deep tilth.

Wheat roots have been traced 7 ft. in depth, and it is believed that they penetrate to a depth equal to the length of the plant above ground under favorable circumstances. Depth of roots.

The work of the plow and that of the cultivator are very different, and the questions of deep *plowing* and deep *stirring* must be keep entirely distinct. Deep cultivation, not necessarily deep plowing.

To turn up to the surface raw and unfertilized land in great quantities is to injure the productiveness for a term of years. But to keep the soil deeply stirred, preserving in great degree the relative imposition of soil on subsoil, mixing in degree and opening to increase aëration, and permit the passage of water and the deep rooting of the plants is the essential of improved agriculture.

Some injury has been done to the cause of deep plowing from the indiscriminate use of it for whatever crop the land may have been intended, and in some cases regardless of the character and condition of the subsoil and the depth of the surface soil. Need of discrimination.

The English authorities recommend that for "green crops" the ground should be *cultivated* at least from 12″ to 24″ in depth, say once in every 4 years, stirring up the soil, but not bringing it to the surface, and thus enabling air and water to descend. When wheat and other "white crops" are to be sown, especially on light land, the depth of plowing should not exceed 4″ to 5″ on land subsoiled the previous year. English practice.

By deep plowing both light and heavy lands are kept in a more even condition, the heavy lands not suffering from an excess of water nor the light lands from drought. Advantages in heavy and light soils.

Dispatch of work.

Dispatch of work.

Steam-plowing means the power of pulling, and not necessarily deep plowing or any one system of doing the work; but it does render deep plowing relatively cheap, and is in fact a cheapener of all plowing, as well as doing the work with more dispatch, less expenditure of labor, and is capable of being used at times when it might be difficult to spare horses from other necessary work. Steam culture the cheaper.

Steam culture.

What is done by horses in plowing can be done by steam, but it does not follow that what can be done by steam can be done by horses. The speed of horses is limited, that of steam is practically unlimited. The speed of an implement passing through the soil has a great effect on the nature of the cultivation. The high speed of a *cultivator* is sometimes of the highest advantage, tossing and mixing the soil, which can only be best done by a hard point or share running at high speed.

Greater speed as well as breadth of culture of the implements.

Comparison of steam plows and horses.

The steam-plow at each passage across the field cultivates a breadth equal to that performed by 12 horses with 6 ordinary plows, and in half the time.

Poaching of ground by horses.

To reach the best results in clay land, horses should be kept off the ground entirely, especially in spring.

The conclusion that repeated mechanical applications for reducing clay land to a tilth are very injurious to the soil is being reached by some very enterprising culturists. The plan suggested is to plow in autumn, when the land is dry, independently of animal power, leave to the ameliorating influences of the air and weather, and then harrow in spring. Owners of clay land, who have been, as it were, pitied until the clay soil has become a proverb, are now coming to the front with the declaration that, by the aid of steam, stiff-clay land can be cultivated at a less cost than light land, as but one operation is required for cleaning it, provided it be done in a proper manner—work in fall to bring it to a tilth and harrow in spring to prepare a seed-bed.

New practice with heavy clay soils.

Effect of a single cultivation to 30″ depth.

In illustration, one item of experience may be adduced in which a clay soil, stirred to a depth of 30″ by the steam-grubber* (technically known as a "knifer"), was nearly doubled in value, and a horse could be ridden over it after heavy rain without sinking.

This deep stirring is not necessary more than once in five years, the surface soil only being worked in the intervals. Where root crops are grown the deep stirring precedes the green crop.

Steam culture follows in the wake of steam transportation.

Steam in cultivation must make a revolution, as it has done by land and by sea, in railways and steamships. It is the natural order of events.

Command of opportunities in favorable seasons.

To have a command of labor at any given time is essential to the proper cultivation of the soil, and it is sometimes impossible to command horse-power enough to plow the land in the requisite time; as, for instance, in August plowing-under of stubble a summer fallow may be obtained after

* See Fig. 85, page 83.

the crop comes off equal to the old horse-plowed fallows which have laid all the year unproductive. *Steam culture.*

An exact statement of crops, fallows, and seasons will not of course answer for any other country than that for which it is prepared, but the August fallow is simply cited for an example and is true in some places, while another illustration would fit the circumstances of another place more exactly.

History. History.

Experiments in steam-plowing began in England about 1850. Experiments in 1850.

It is usually the case that in any great change of method attempts are made to follow the previous system so far as possible, merely adapting the new idea to the former system. This was the case in the present instance, the idea that first occurred being to hitch the engine to the plow and draw it over the field, the moving engine being a substitute for a team of horses. We have tried the same in the United States, and the failure of that system on both sides of the Atlantic is complete. The futile attempts on the traveling-engine system.

Moving the implements by wire-rope traction was introduced by John Fowler in 1855; and in 1866 the same inventor introduced his double-engine sets, which are the most effective, and this system includes the majority of the tackles in use at the present time. Wire-rope traction by Fowler in 1855. Double-engine sets, 1866.

Since 1866 the machinery has been so much improved that the wear and tear are reduced to one-fourth, the capacity of a machine of given nominal power more than doubled, the character of the work greatly improved, and the cost of the machine of given capacity much reduced. Increased power and decreased cost of plant.

Steam cultivation is now well established in Europe. In England and Scotland there are more than 3,000 steam-cultivating engines employed at present, most of them worked by landholders and tenants, but many of them owned by companies working for hire. Steam culture well established in Europe.

Egypt has been a very important customer for its cotton and sugar lands. The Khedive purchased 250 full sets of tackle from Fowler & Co.; Halim Pacha 27 tackles. Altogether about 400 tackles have been sent to that country in the last 12 years. The usual depth of plowing in the Nile soil is understood to be 14″. Steam culture in Egypt.

Germany and Austria-Hungary, especially in the beet-root-producing regions, have several hundred steam-tackles at the present time. Germany, &c.

The West Indies, Demerara, and Peru have become steady and constant buyers of steam-plowing machinery. West Indies, &c.

Steam culture.

In various European countries.

A more limited number of steam-plows is to be found in Russia, France, Italy, and Spain. To explain the reasons which delay their more rapid introduction into those countries would take up too much space. They are certainly not to be found in the machinery, which works as well on the flat, prairie-like plains of the Wolga as on the hillsides of Bohemia and other less favorable countries.

Works of John Fowler & Co., Leeds, England.

John Fowler & Co., in their works at Leeds, England, employ about 1,300 men exclusively in the production of steam-cultivating machinery, and turn out from 6 to 10 engines per week.

J. & F. Howard, Bedford, England.

The firm of J. & F. Howard, of Bedford, has supplied steam-cultivating machinery to Great Britain, France, Germany, Denmark, Sweden, Italy, Switzerland, Spain, Portugal, Greece, Turkey, Hungary, the Danubian principalities, Russia, Egypt, India, America, Australia, and New Zealand.

Steam plowing companies in Great Britain.

There are about 120 companies plowing for hire in Great Britain. One at Grantham, Lincolnshire, which started with 3 tackles ten years ago, now has 16 full double sets, costing £1,800 each. Another company has 20 double sets.

M. Decauville. Petit - Bourg, France.

On the estate of M. Decauville at Petit-Bourg, where the official trial of plows of all kinds took place, including steam-cultivating machinery, 2 double sets are in use. One was first purchased and found inadequate to the intensive culture of the farm of 300 hectares (say 750 acres). Beet-root occupies about one-third of the area, alternating with wheat and lucern.

Duke of Sutherland.

The Duke of Sutherland employs 16 large plowing engines in reclaiming tracts of wild land.

The facts stated are sufficient to prove that steam-plowing has become a practical fact which should be carefully considered by our inventors, mechanics, manufacturers, and farmers.

Three effective systems.

Systems.

Of the many schemes and systems which have been brought before the public three only have proved successful. In each of these the traction power is transmitted to the implement through a steel-wire rope winding upon a drum.

Direct or double-engine system.

1. The *direct or double-engine system*, in which each of the winding drums is placed under the boiler of a self-moving steam-engine. The engines traveling along the headlands at opposite sides of the field alternately pull the plow across the field; while one is pulling the other moves forward the width of the row of furrows.

Single-engine and anchor system.

2. The *single-engine and opposite-headland-anchor system.* The locomobile moves along one headland and the anchor,

with a pulley, traverses along the other. The engine has a pair of drums, upon which the wire-rope is alternately wound, the bight of the rope passing around the pulley on the traveling anchor at the other side of the field. *Steam culture.*

3. The *roundabout system*, in which the winding-drums are fixed in a windlass frame and connected to a portable engine, which is made stationary in a corner of the field. One end of each rope is made fast to the plow, and the implement is drawn forward and backward by the drums pulling alternately; the pulley-sheaves and anchors at each end of the furrow move forward as the plowing proceeds. Roundabout system.

The comparative advantages and disadvantages of the systems will be referred to when describing them.

The traveling engine and plow.

Traveling engine and plow system.

This plan, upon which so much money has been wasted in the United States, need occupy but sufficient room to condemn it. It was the one originally attempted both in England and in the United States, and may be mentioned first as it was first in point of date, and to clear the ground for the display of what is really valuable.

The persistent attempts in this false direction have greatly retarded the progress of the invention both in England and in the United States, and it is not perhaps too much to say that the discouragement arising from these abortive efforts is at present the cause of our being behind so many other countries in the introduction of steam-plowing. Unfortunate persistent attempts in this direction.

It is estimated that an average of 75 per cent. of the power of the engine is consumed in traveling, leaving only 25 per cent. for effective force in drawing the plow or other implement, while the difficulty of moving in hilly, loose, or damp soils, and the damage done to the ground, it would seem, should have long ago taught a sensible and practical people that they were working on a false method. The reasons why it does not succeed.

The double-engine system.

Double-engine system.

This is the most expensive system in the first cost and the most economical in the cost of plowing per acre. Its adoption will be determined by the ability of the purchaser to invest the required amount, and by his command of sufficient land to require apparatus of the greatest working capacity. The most expensive and most efficient.

Steam culture. Double-engine system.

Howard's prices.

Howard's prices are:

For a steam cultivating apparatus with 2 8-horse self-moving engines, 800 yards of steel-wire rope, and 6 rope-porters	£1,100
Steam-plow for 4 furrows	70
Steam-cultivator with 7 tines	55
Steam-harrow, 11 ft. wide	25
	1,250

Fowler's prices.

Fowler's:

2 8-horse-power engines	£1,170
800 yards steel-wire rope	76
4-furrow steel plow	102
7-tine cultivator	81
Harrow	55
	1,484

Aveling & Porter's prices.

Aveling & Porter:

2 8-horse-power engines	£1,370
4-furrow balance-plow	100
7-tine turning cultivator	90
Harrow, $3^{m}.10$ wide	100
800 yards wire rope, say	76
	1,736

These figures may be compared with those of the other systems.

Fowler & Co.

Take the tackle of John Fowler & Co., of Leeds, England, to illustrate the "double-engine system." This, as has been said, is the best when the means and the needs agree; but it is needless to provide such a plant unless the amount of land justifies it. Ninety per cent. of the plow-tackles made by Fowler are on this system.

Tackles furnished to Egypt.

Wherever the steam-plow has been introduced in quantity this is the plan adopted, as in the case of the 27 tackles furnished by Fowler to Halim Pacha and the 250 full equipments to the Khedive, for plowing the vast alluvial lands of Egypt, when his vice-royalty went into the cultivation of cotton, and 14″ depth of tillage was considered expedient. As the soil of Egypt is estimated to be permanently raised by the overflowing Nile six inches in a century at Heliopolis (more above and less below that point in the valley), the steam-plow has been turning up, we may say, the deposit of the time when the Sultan was a terror to Vienna, and William III of England and Louis XIV of France fought in Flanders, where Uncle Toby's brother soldiers "swore terribly;" when Vauban's great citadel of Sedan witnessed the triumphs of Turenne and not the sad reverses of later times.

The *two-engine system* (Fig. 63) has two engines, with a winding-drum to each, working along opposite headlands, to draw a plow, cultivator, or other implement from one

Steam culture.

Double-engine system.

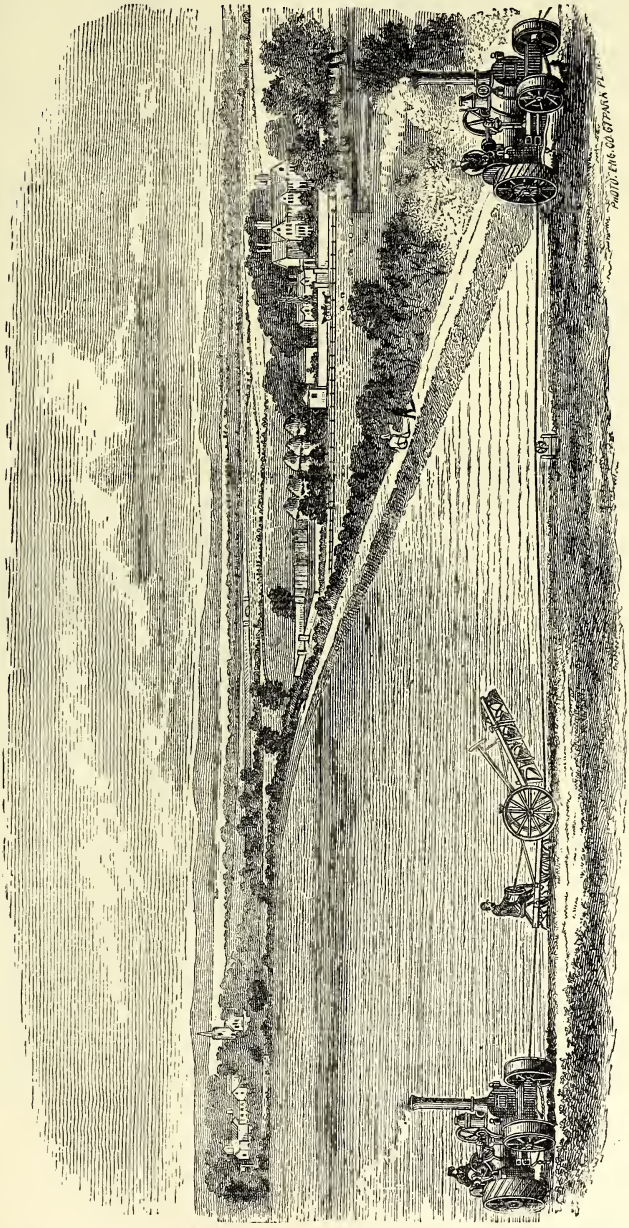


FIG. 63.—*Double-engine steam-plowing tackle. John Fowler & Co., Leeds, England.*

Mode of installation.

Fowler & Co.

engine to the other, alternately. Two engine-drivers, a plowman, and one or two boys to attend to the rope-porters are required.

Description.

Steam culture.

Double-engine system.

The following are the principal advantages of this system: Less rope is required, the amount necessary being only sufficient to go twice across the field; there being no fixtures in the field, less time is lost in setting to work and removing; and the manual labor in proportion to the work done is somewhat less.

Advantages.

It may be added, also, that the engines are ready to start into a fresh field the moment they stop work, and can remove themselves and the whole of the apparatus without any additional manual or animal labor. The labor of getting from field to field is really one of the principal difficulties.

Steam-plowing engine. Fowler & Co.

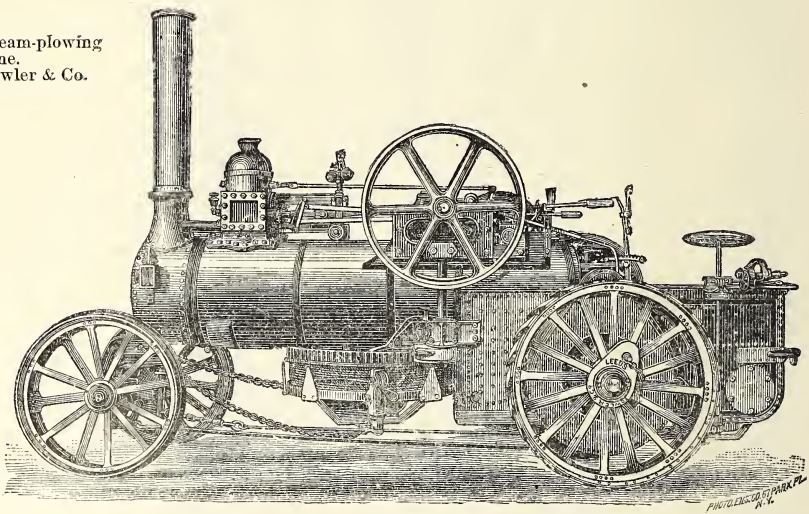


FIG. 64.—*Steam-plowing engine. John Fowler & Co., Leeds, England.*

Description.

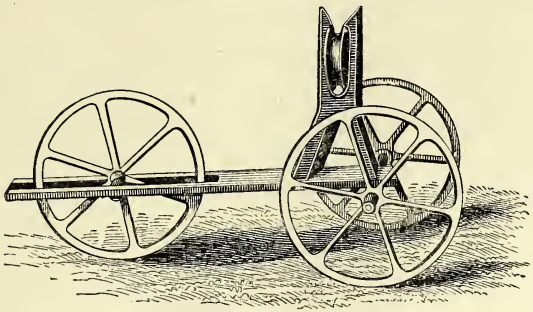
The engines of this system are made of 6, 8, 14, and 20 horse-power (Fig. 64). They have single steam-jacketed cylinders and are provided with steam-domes. The road-gear is constructed of spur-wheels made of cast steel. The road-wheels are of wrought iron with a tread of from 14″ to 24″ wide, according to the size of the engine. The engine has two traveling speeds and is available as a common traction or an ordinary portable-engine, and can be used for any agricultural purpose, such as thrashing, pumping, grinding, sawing, etc.

Winding apparatus.

The power is conveyed to the winding-drum by an upright shaft from the crank-shaft. The winding apparatus consists of a horizontal drum, which, by means of a coiling-gear, winds and unwinds the wire rope uniformly without any attention from the man in charge. This is done by a self-acting lever which carries two vertical guide-pulleys,

moving slowly up and down, and freely swinging round the drum into any position at which the rope has to work.

Steam culture.
Double-engine system.



Rope-porter.

FIG. 65.—*Rope-porter. John Fowler & Co., Leeds, England.*

The rope-porters (Fig. 65) are placed along the line of the rope at intervals of about 120 ft. to keep the rope off the

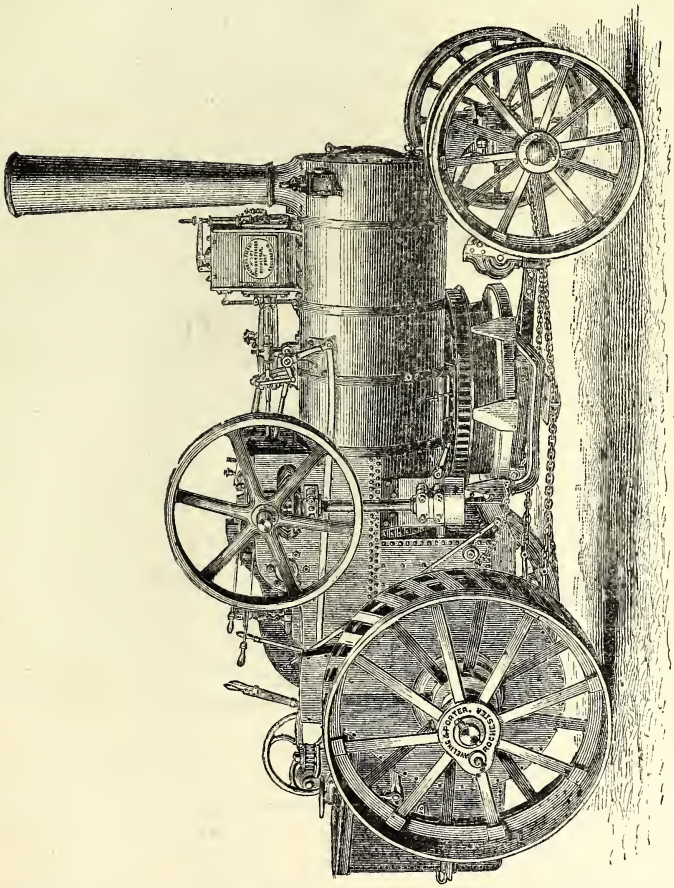


FIG. 66.—*Locomotive for the double-engine system. Aveling & Porter, Rochester, England.*

Steam-plowing engine. Aveling & Porter.

ground. They are mounted on three wheels so as to allow them to be moved sideways by the rope, and are shifted out

Rope-porter. (Figure 65.)

Steam culture.

Double-engine system.

of the way of the implement by a boy who walks a little in advance of the plow or other implement.

Price of rope porter, light, £1; heavy, £1 10*s*.

Aveling & Porter's steam-plowing engine. (Figure 66.)

Aveling & Porter's engines (Fig. 66)for the *double-engine system* are made in pairs, in order that when placed opposite each other in the field they shall both drive, as well as draw, from the furrow side—an improvement which has effected an important saving in the wear and tear of the winding-drums.

Farmer's engine for all purposes.

J. & F. Howard.

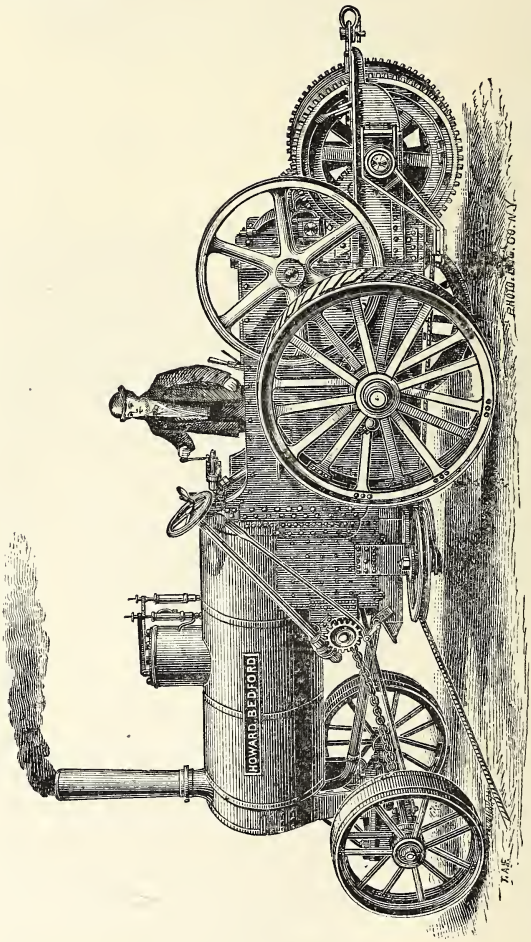


FIG. 67.—*Farmer's engine for all purposes. James & Frederick Howard, Bedford, England.*

Description of Aveling & Porter's engine. (Figure 66.)

They are fitted with coiling-gear arranged so as to lay the rope uniformly on the drum without attention from the man in charge, and, as the drum is placed horizontally, the rope can take any angle the direction of the furrow may require, without putting pressure on the coiling-gear. The engines have single cylinders, with lagged steam-jackets, and placed

on the forward part of the boiler. The crank-shaft, driving-axle, and counter-shaft have their bearings made in the extended side-plates of the fire-box, so that the boiler is saved from the injurious tension of the working parts, and the usual cast-iron brackets and plummer-blocks are dispensed with.

Steam culture.

Double-engine system.

The agricultural and traction engine of Howard (Fig. 67) is a compromise, or rather it is designed for all the three systems of work: the *double engine*, the *single engine with headland anchor opposite*, and the *roundabout*.

Howard's engine. (Figure 67.)

Two farmers, each possessing one of these engines, may work them together upon the double system without change of any kind, with the additional advantage of being able to work them separately upon either of the single systems.

Advantages of the protean engine.

The windlass is mounted upon the engine in such a manner that it can be easily and quickly detached, thus relieving the engine of all the weight and incumbrance of the winding-gear when it is to be used for the other work of the farm, thrashing, sawing, pumping, grinding, and what not.

The dismountable windlass.

The engine-work and traction-gear are mounted upon the tender instead of upon the boiler, the latter being thus removed from the strains of the machinery, the working parts of the engine being within reach and in sight of the driver. This arrangement admits of the engine, with the tender, being detached from the boiler when the latter requires repair or renewal, and this without taking the engine portion or gear to pieces.

Advantages of the construction.

Bevel-gearing is dispensed with, spur-wheels being used both for winding-drums and for propelling-gear. The traveling-wheels are of wrought iron; the main axles, crank-shaft, and gearing are steel. The winding-drum is placed in rear of the engine, and the rope taken off at any angle from a pulley fixed under the boiler in the best position for taking the strain. This arrangement permits the use of winding-drums with horizontal shafts, and the strain is to a certain extent divided between the drum and the pulley. The coiling arrangement flits the rope, without bending it, over small coiling-sheaves, no matter how unlevel the ground may be. Price, 8-horse power with 2 winding-drums, £520.

Description of the structure.

Price.

The single-engine and opposite-headland-anchor system.

Single-engine and opposite-headland-anchor system.

This plan admits of either the direct or indirect method of working. The engine may either work along one headland with an anchor on the opposite headland, and thus have a direct pull upon the implement, the engine and anchor advancing from time to time as the work proceeds; or

Steam culture.

the engine may stand in a corner of the field and work the implement by means of snatch-blocks.

Single-engine and headland-anchor system.

The former of these methods is shown in black lines and the latter in dotted lines in the plan of installation (Fig. 68).

Plan of installation.

The system requires an 8 or 12 horse-power double-drum winding engine, movable head-land anchor, 1,600 yards of

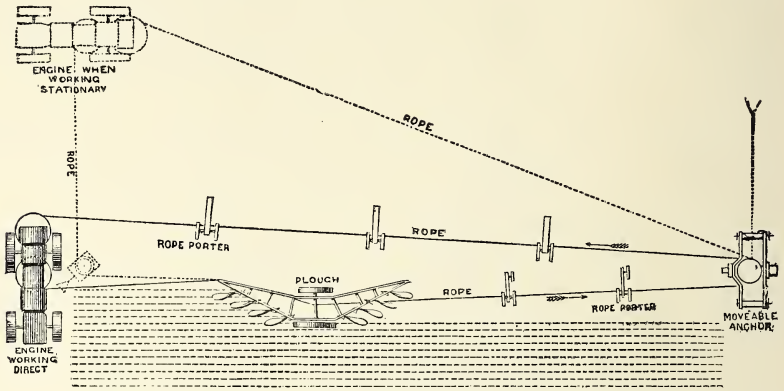


FIG. 68.—*Single-engine and headland-anchor plan of installation.*

Appurtenances.

steel-wire rope, 2 claw-anchors, 2 snatch-blocks, 20 rope-porters, and the necessary implements. For working direct, as in black lines on the plan of installation, but 1,200 yards of wire rope are required.

Fowler & Co.'s engine.

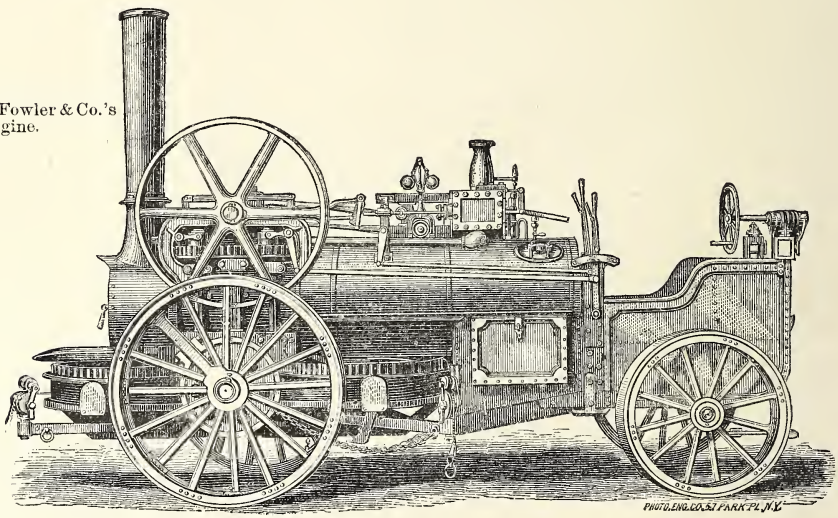


FIG. 69.—*Engine with two winding-drums. John Fowler & Co., Leeds, England.*

Comparison of the two plans of installation. (Figure 68.)

Each method has some advantages, and this system permits of either. The *direct* requires less rope, and the apparatus is more easily put to work and taken up; the sta-

tionary arrangement avoids the necessity of traveling the engine along the headland when circumstances, such as very hilly ground, irregular fences, or a very wet condition of the soil, make it desirable that the engine should not be taken upon the land.

Steam culture.

Single-engine and headland-anchor system.

Where the amount of capital or the extent of land does not justify the purchase of the double-engine tackle, this arrangement offers the farmer the benefits of two systems.

Advantages.

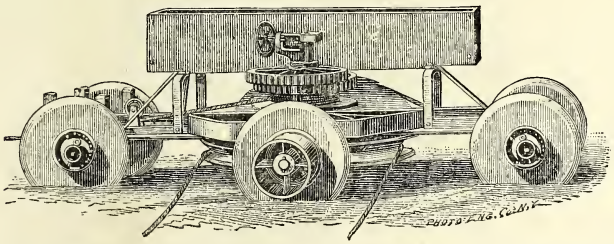
The engine (Fig. 69) is similar to those described under the *double-engine system*, the chief point of difference being that it is furnished with two winding-drums, each having coiling-gear for laying the rope regularly and automatically upon the drums.

Engines. Figures 64 and 69 compared.

The headland anchor (Fig. 70) is a wrought-iron frame, carrying a horizontal sheave, and resting on thin disk-wheels, which cut into the ground and resist the side strain of the engine and implements. It is moved along the headland by the motion of the sheave or pulley, which is turned by the rope; the sheave is connected by gear to a drum, which winds up a rope stretched along the headland (shown at the right hand in the installation plan, Figure 68), and keeps the anchor opposite to its work. The anchor is provided with a steerage, which enables it to be worked along a crooked headland, and is managed by a boy, who also attends to shifting rope-porters. The box at the back is intended as a counterpoise to prevent the anchor being pulled over when doing very heavy work.

Headland anchor.

Its construction and mode of working.



Headland anchor.

FIG. 70.—*Movable headland anchor. John Fowler & Co., Leeds, England.*

Price of 8-horse-power engine, self-moving anchor, and all parts, ropes, appendages, and tools complete, with the extra parts necessary when working the engine stationary, but without the implements, £808.

Price of plant.

The roundabout system.

Roundabout system.

Take, as an illustration of the roundabout system, the tackle of Aveling & Porter, of Rochester, England.

The engine used (Fig. 71) is that called by them the "agricultural locomotive engine," and is designed for steam

Aveling & Porter's engine.

Steam culture. cultivation, thrashing, sawing, pumping, and hauling. The boiler is unusually large, and is tested up to 200 lbs. It

Roundabout system. has a single steam-jacketed cylinder, mounted on the fore end of the boiler, to prevent priming and to economize fuel.

Aveling & Porter's engine. The bearings of the crank-shaft, counter-shaft, and driving-axle are carried by the side-plates of the fire-box, extended upward and backward in one piece for this purpose, and

Description. designed to save the boiler from strain. The driving-wheels are of iron. The engine is steered from the foot-plate.

Each engine has fly-wheel, governor, and a brake.

Price. Price of engine, 8-horse power, £680.

Aveling & Porter's locomotive for all purposes.

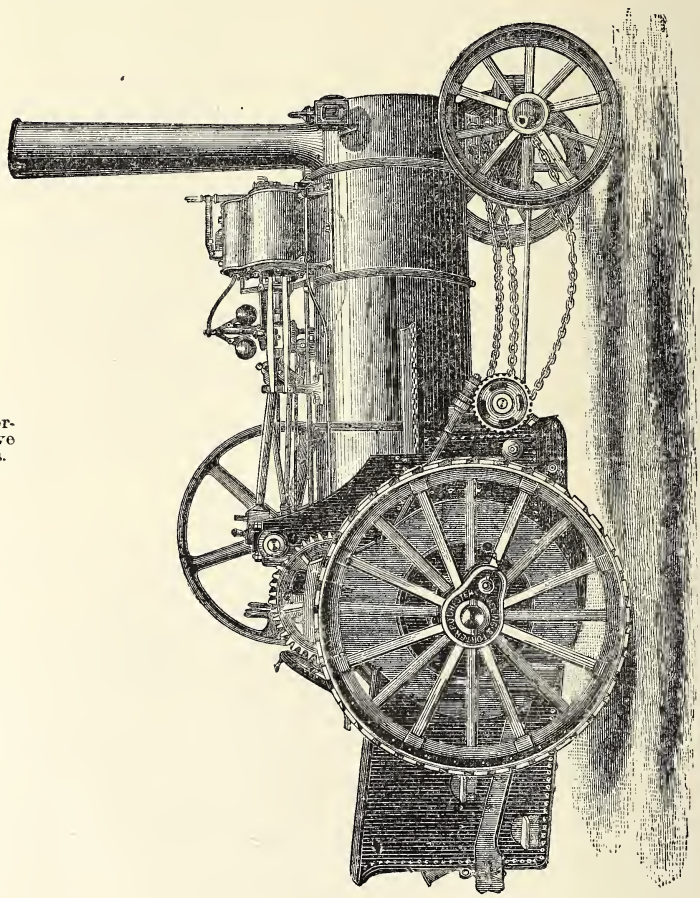


FIG. 71.—*Agricultural locomotive. Aveling & Porter, Rochester, England.*

Plan of installation. (Figure 72.) The tackle shown in the plan view (Fig. 72) of the round-about system consists of an agricultural locomotive and a detached winding-windlass on a carriage, both placed and anchored in a position at one corner of and outside the ground to be plowed. Besides these, there are claw-anchors

for two other corners and a snatch-block for the fourth; two traveling-anchors, which are moved as the plowing proceeds, to keep them in line with the work. A number of

Steam culture. Roundabout system. Aveling & Porter.

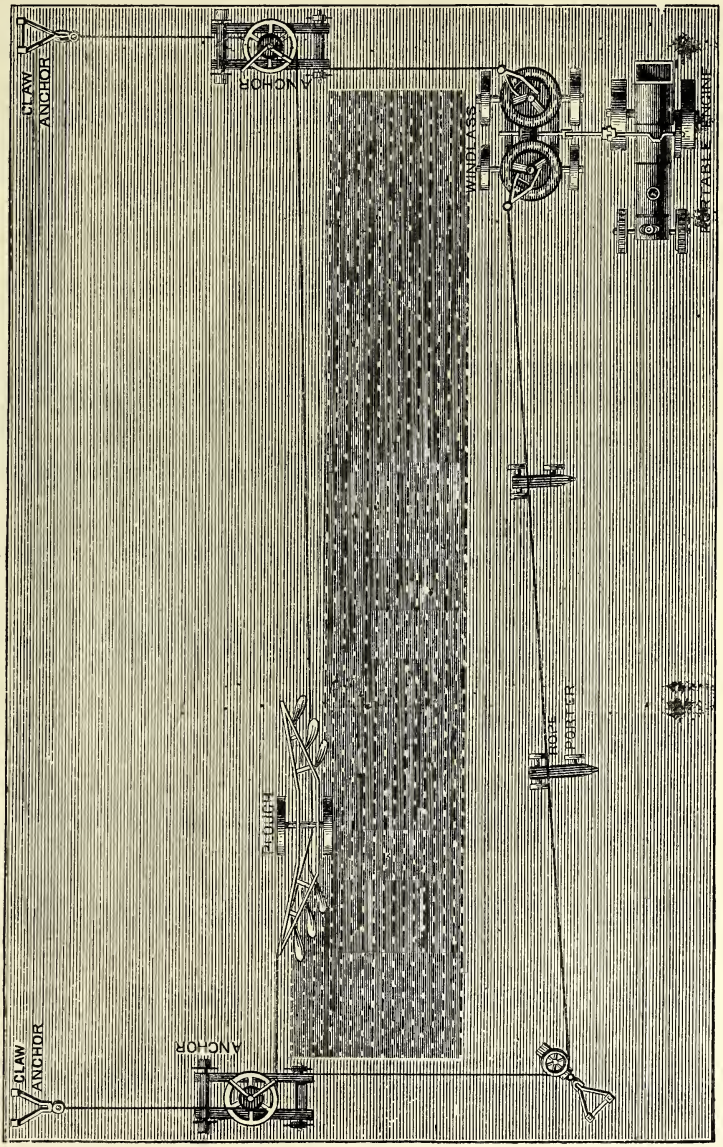


FIG. 72.—*Round-about plan of installation.*

rope-porters keep the wire rope from dragging. One thousand six hundred yards of wire rope is the usual amount furnished, about equal to encircling a square field of 32 acres.

Steam culture.

Roundabout system.

Description of the plan of installation. (Figure 72.)

The method of working will be readily seen from the plan; the engine, being driven in one direction, rotates the right-hand drum of the windlass, and moves the plow toward the right of the field, as shown. The plow having reached the end of its furrow, the motion of the engine is reversed, the other end of the balance-plow brought down to the earth, and the implement returns across the field. The anchors are automatically moved towards their claw-anchors, each one, alternately, the width of the four furrows at each passage of the plow.

Windlass for roundabout system. Fowler & Co.

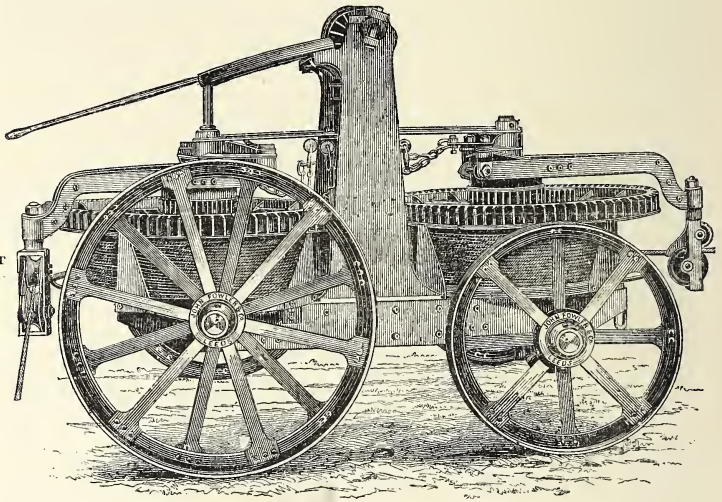


FIG. 73.—*Windlass for the roundabout system. John Fowler & Co., Leeds, England.*

Fowler's tackle.

The Fowler tackle on the *roundabout system* has an engine with a steam-jacketed single cylinder and steam-dome, and, with the exception of its being devoid of winding-drum, has many points of special construction similar to the engine described under the sub-title *double-engine system.*

Anchor for the roundabout system. Fowler & Co.

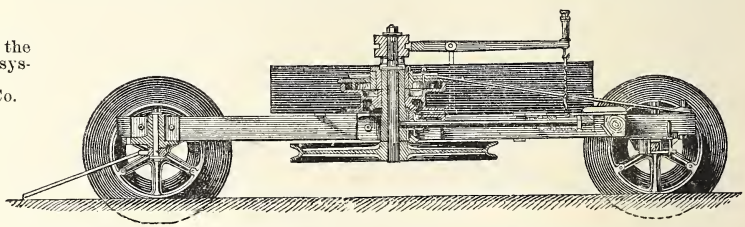


FIG. 74.—*Anchor for the roundabout system. John Fowler & Co., Leeds, England.*

It, however, is, or may be, an ordinary portable or traction engine which has a transverse shaft above, connecting by gimbal joint and line shaft to a shaft on the detached wind-

lass, which stands parallel with the engine, as shown in the plan of installation (Fig. 72). *Steam culture.*

The windlass (Fig. 73) is constructed on four wrought-iron road-wheels, and the winding apparatus consists of two horizontal drums, which, by means of coiling-gear, wind and unwind the wire rope uniformly without any attention. This is done by a self-acting lever, which carries two vertical guide-pulleys, moving slowly up and down, and freely swinging round the drum into any position to agree with the direction in which the rope has to work. Roundabout system. Description of self-acting windlass. (Figure 73.)

The rope pays out from the drum, at any angle required by the work, without snatch-blocks being necessary.

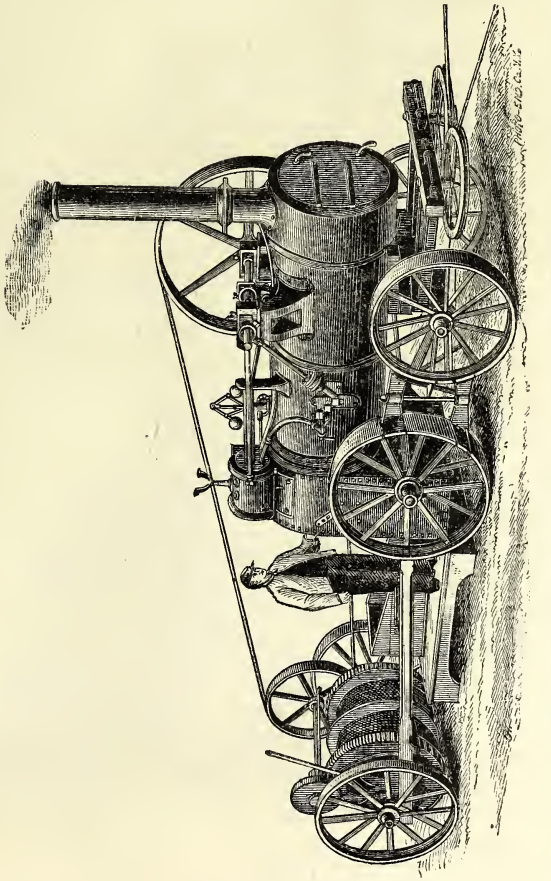


FIG. 75.—*Portable engine and rear windlass for the roundabout system. James & Frederick Howard, Bedford, England.*

Tackle for roundabout system. J. & F. Howard.

The anchor (Fig. 74) is so constructed as to be pulled forward by an auxiliary rope on the headland, which is wound on a small drum put in motion by the main sheave. The connection between this drum and the sheave being released, the anchor becomes stationary. The side strain of the plow- Description of anchor. (Figure 74.)

Steam culture.

ing-ropes is resisted by the disks which are fixed to the wheels and imbed themselves in the ground.

Roundabout system.

As the anchor travels away from the headland on which the engine is fixed, it is firmly held in place by the strain of the plowing-rope in one direction and the strain of the winding-forward rope in the other. The slow and sure forward motion secures the perfect cutting in of the disk-wheels, and therefore its lateral steadiness.

The anchor. (Figure 74.)

Price of Fowler's roundabout tackle.

Price of Fowler's roundabout tackle, with 8-horse-power engine and all its appendages complete, windlass, steel ropes, 2 self-moving anchors, snatch-blocks, claw-anchors, and rope-porters, and a 5-tine turning cultivator, £975.

Howard's tackle. (Figure 75.)

Howard's engine (Fig. 75), with rear windlass, is an adaptation to steam cultivation of the ordinary thrashing engine. It is not self-moving, and the engine and windlass are detached when moving from field to field, and are connected when at work by a single bolt.

The necessary guide-pulleys are attached to the fore carriage of the engine, and the weight of the engine is used as an anchorage both for the windlass and for the guide-pulleys which lead off the ropes.

Roundabout tackle of Barford & Perkins.

The firm of Barford & Perkins, of Peterborough, England, has two forms of roundabout tackle. In one (Fig. 76) an ordinary portable engine is fitted with a wheel connected by chain with the driving-shaft of the windlass.

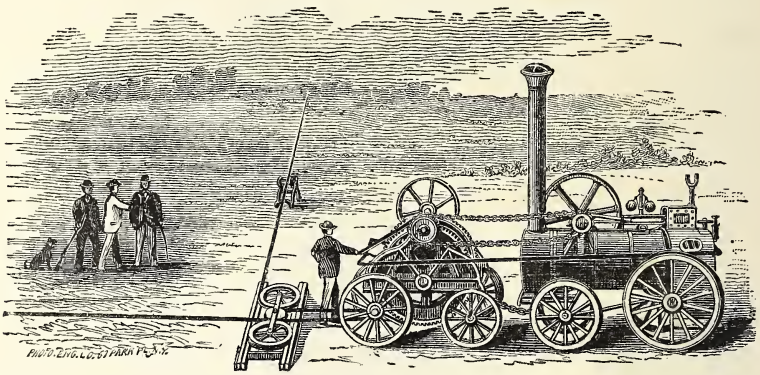


FIG. 76.—*Roundabout system, with detached windlass. Barford & Perkins, Peterborough, England.*

Two plans of installation. (Figures 76, 77.)

In another method (Fig. 77) the windlass and engine are combined and the two wire-ropes wind upon drums on the main axle, the machine being lifted clear of the soil so that the ground-wheels and drums upon them may revolve.

Steam culture.

Price, with detached windlass (Fig. 76):

8-horse-power portable engine	£210
Windlass, 1,600 yards steel-wire rope, self-moving and self-acting anchors, common anchors, snatch-blocks, porters, and a 5-tine cultivator	350
4-furrow steam-plow	80
	640

Roundabout system.

Price of Barford & Perkins' tackle. (Figure 76.)

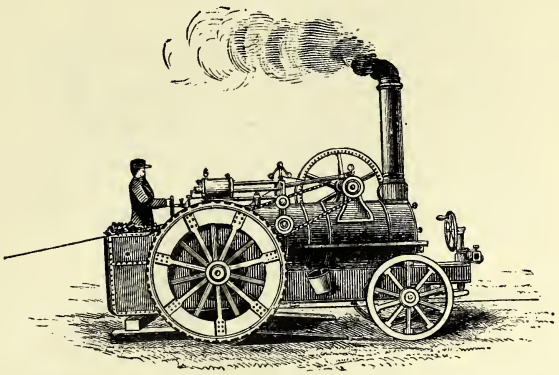


FIG. 77.—*Roundabout system, engine and windlass combined. Barford & Perkins, Peterborough, England.*

Price of tackle. (Figure 77.)

Combined engine and windlass (Fig. 77):

10-horse power, with full tackle of self-acting and self-moving anchors, common anchors, snatch-blocks, rope-porters, 7-tine cultivator, 4-furrow plow, and 1,800 yards steel rope £900

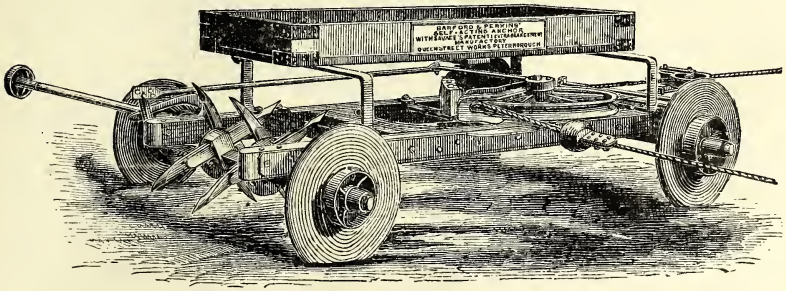


FIG. 78.—*Self-acting and self-moving anchor. Barford & Perkins, Peterborough, England.*

Self-acting anchor. Barford & Perkins.

The form of anchor shown in Fig. 78 is designed for the roundabout system. Two anchors are employed, occupying positions opposite to each other on the headlands, and proceeding at a right angle to the course of the plow. This form of anchor is automatically moved the regulated distance, equal to the width of cultivation of the implement at one passage, and this without the draw-rope reaching to a claw-anchor at the other end of the field, as in figure 72.

Price.

Price, £50.

Steam culture.

Roundabout system.

E. Bodin, of Trois-Croix, Rennes, France, has a form of Howard apparatus (Fig. 79) with vertical drums on the windlass, which stands parallel with the locomobile, and is

Howard's tackle.

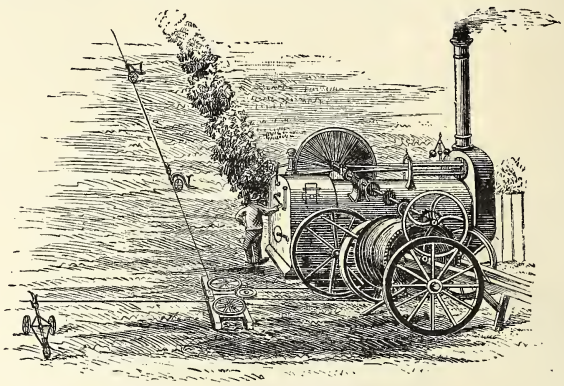


FIG. 79.—*Howard's roundabout tackle. E. Bodin, Rennes, France.*

driven by line-shaft connection between the portions of the apparatus.

Debains' tackle. (Figures 80, 81.)

The apparatus of Alfred Debains, of Saint-Remy-Claire-fontaine, near Rambouillet (*Seine-et-Oise*), France (Fig. 80), is on the roundabout system, in which the winding machine is a separate structure, which is attached to an ordinary locomobile when the latter is to be used to work a steam-plow, allowing the engine to be used at other times for the ordinary work of the farm, to run a thrashing machine, straw-cutter, pump, cider-mill, grain-mill, etc.

General work steam-engine.

The winding apparatus for the cable is on a separate carriage, attached at will to the locomobile, and the gearing is driven by a band-wheel from the fly-wheel of the engine.

Use of portable steam-engine.

The use of portable engines on farms has become very common, and the purchase of winding-tender, with its accessories of cable, anchors, pulleys, and plow, puts the owner of the engine in possession of the complete "tackle," as the English term it, or, as we might say, a complete "rig."

Price of tackle, without engine.

	Francs.
Debains' tender, with winding apparatus, anchors, pulleys, cables	9,500
Gang-plow with 4 shares	2,500
	12,000

Description.

The tender has three winding-drums on a single axis, the pinion on the pulley-shaft being engaged with such of the cog-wheels as may be required. One winds the cable in one direction, another letting the cable run off. The action of these two is reversed when the plow is to move in the other direction. The third drum has a separate cable, anchored

Steam culture.

at some distance in advance of the steam-apparatus and in the direction of its line of motion, by which the winding-tender and engine are moved from time to time between each passage of the plow a distance equal to the width of ground plowed.

Roundabout system.

These three are all the motions required during work, and a fourth, by which the wheels of the machine are rotated so

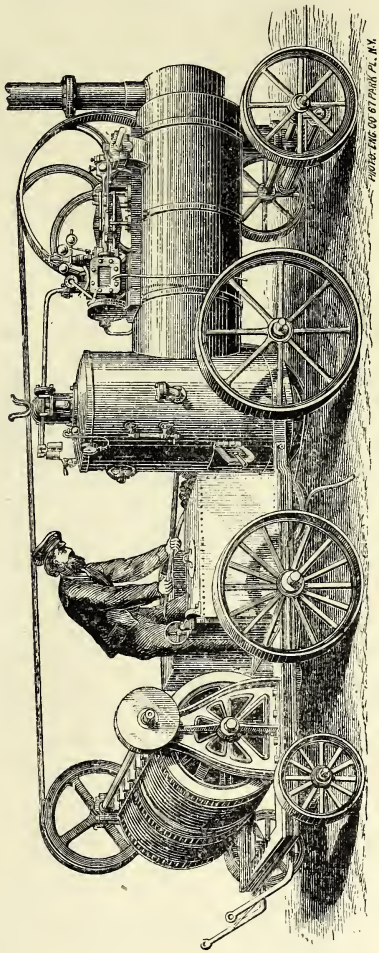


FIG. 80.—*Engine and windlass for the roundabout system. A. Debains, Saint-Remy, France.*

Debains' tackle.

as to move the apparatus to and from the field, would complete the category, but in fact it is drawn by horses when transporting it to and from work.

The "tackle"—using the general term to include the whole apparatus—works upon the *roundabout* plan, also made by Fowler, Aveling & Porter, Howard, and others.

Fig. 81 shows the plan of installation.

Steam culture.

Roundabout system.

Plan of installation of Debains' tackle.

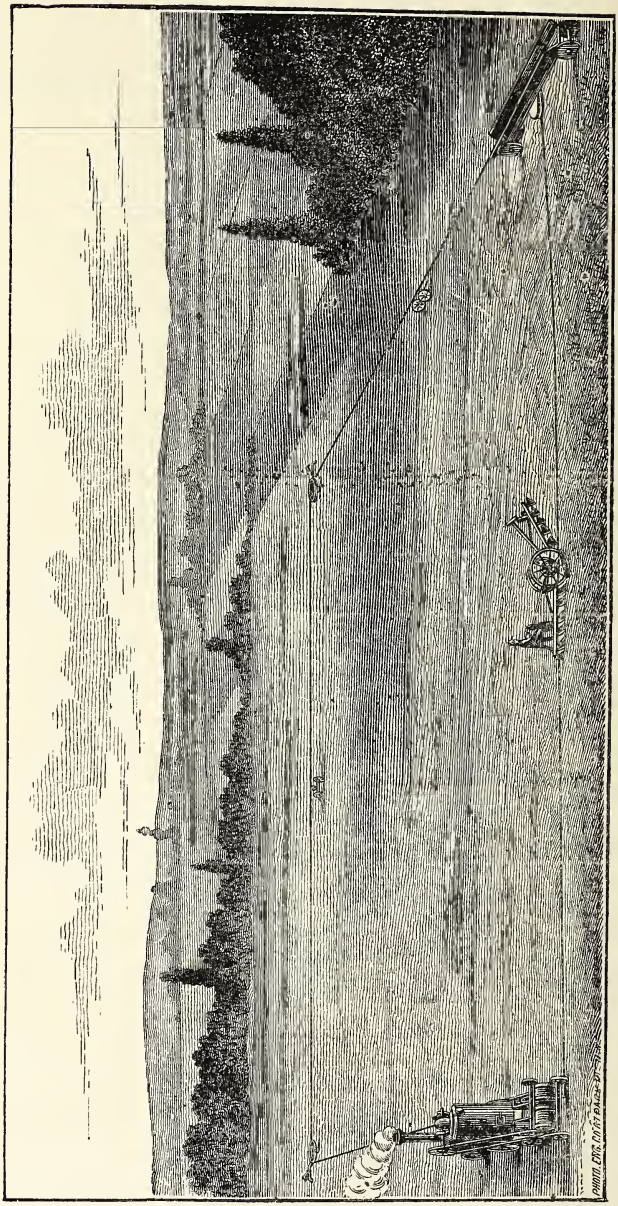


FIG. 81.—*Installation of the roundabout system of A. Debains, Saint-Remy, France.*

Implements. *Steam culture.*

For the purposes of steam culture all of the following implements are not necessary in any one place, but each of them has its duty under varying circumstances of countries, soils, or seasons. Implements.

Special implements are adapted for clearing, draining, breaking up land infested by stones, troubled with roots, soused by water, or choked by wild grasses and aquatic woody growth. Special implements.

They are more ordinarily intended for plowing, cultivating, harrowing, and seeding soils already subdued to cultivation, or such prairie lands or bottoms as offer no particular obstructions to the passage of the implement.

It is needless to say that full sets are only necessary where there is sufficient land to demand their use; but this need not be all in the possession of one proprietor, as many sets of tackle are held in common by several farmers, and in other cases plowing is followed as a business by parties owning the tackle. Witness, for instance, the 120 companies plowing for hire in England, one owning 16 double sets. Sets of tackle held jointly. Plowing companies.

The balance-plow (Fig. 82) is the best result of all the attempts to adapt an instrument for the to-and-fro method of working. One set turns the furrow slice to the right and the other to the left, so that the forward plow in each case throws its slice into the furrow last made on the previous passage. Many attempts at a turning-plow were made before the very effective balance-plow was invented, and now it enters into all the effective systems of steam culture. Balance-plow; the result of extensive experience.

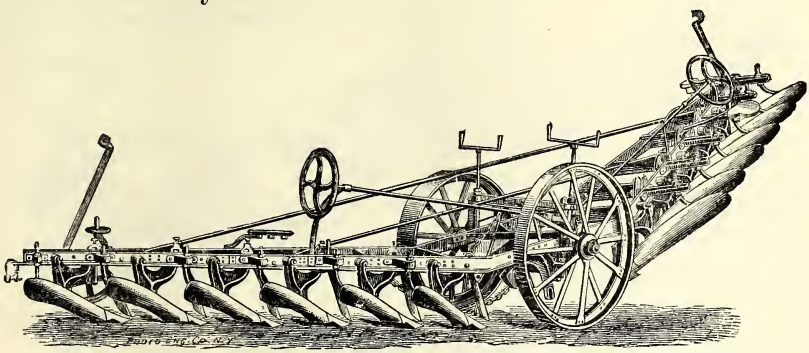


FIG. 82.—6-*furrow balance-plow. John Fowler & Co., Leeds, England.*

The rigid iron frame, which is so essentially necessary to all steam-driven implements, is still maintained in this latest form of balance-plow, and the alteration of the width of the furrow is effected by means of a wedge which throws the Description.

Steam culture. Implements.

plows at different angles to the frame. This wedge is a substitute for the previous arrangement of bolts and screws, and renders the position of the plow thoroughly rigid.

The frame is so arranged that the shape of the shares and moldboards may be varied to suit the character of the land.

Balance-plow.

By removing the ordinary moldboard used for surface plowing and substituting short ones, or those technically known as "digging breasts," a tillage similar to spade husbandry can be effected.

Plows are made for 2, 3, 4, 5, 6, or 8 furrows, and a harrow or roller can be dragged behind if desired.

Price.

Price (steel), £127.

Three-furrow balance-plow. Fowler & Co.

Messrs. Fowler & Co. also furnish a 3-furrow balance-plow specially constructed for sugar-cane fields. This is in two essential points different from the common plow. The main plow-beam, instead of being a straight diagonal angle-iron, is bent into a zigzag, so as to give plenty of space for roots and cane-stools to pass between the plows. The plow middle, by which the frame is supported, is capable of swinging freely round a vertical center-stud. Thus, in going over

Sugar-cane culture.

the ridges of an old cane-field, especially if these ridges are slanting to the furrow line, the shock which the land-wheel constantly receives is not communicated to the main frame, and the latter retains its position undisturbed by the unevenness and roughness of the ground.

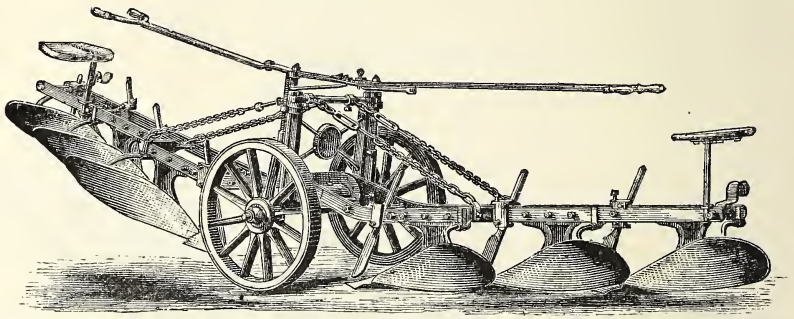


FIG. 83.—3-*furrow balance-plow. Barford & Perkins, Peterborough, England.*

The implement shown in Fig. 83 has an iron frame, steel shares and colters, and wooden wheels.

Price.

Price, 3 furrows, £60; 4 furrows, £80.

Plow and subsoiler. J. & F. Howard. (Figure 84.)

Howard's plow and subsoiler (Fig. 84) for extra deep work is intended to plow from 12″ to 18″ deep.

The subsoiler breaks up the subsoil to a farther depth of from 6″ to 12″, making the depth of cultivation from 18″ to 30″, according to the nature of the soil. The subsoiler is

rigged off to the side of the breaking plow so as to work in the last-made furrow and break up the pan.

Steam culture.

Implements.

Plow and subsoiler.

Price, £90.

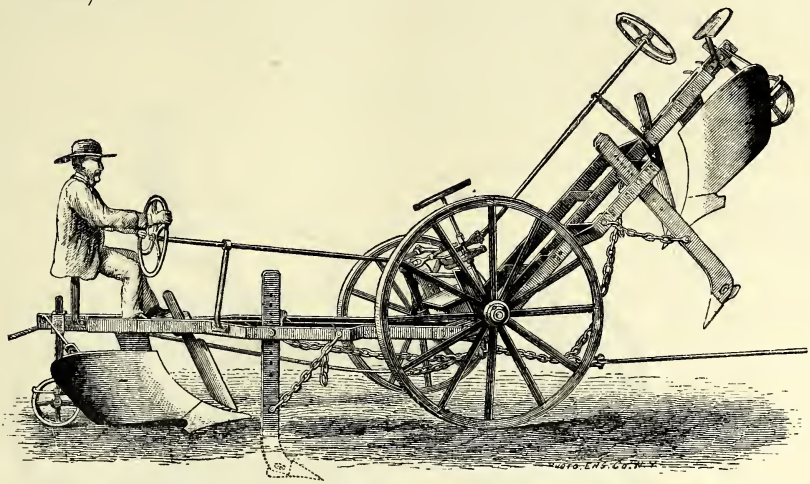


FIG. 84.—*Plow and subsoiler. James & Frederick Howard, Peterborough, England.*

The steam-grubber (Fig. 85) is especially intended for working in stiff clay land, to stir and aërate the subsoil without materially disturbing the surface. For this purpose it is made with 1, 2, or 3 tines, and is worked two feet deep. It is also used for stirring up the subsoil of old grass lands, and with 1 or 2 tines to a depth of as much as 30″ in removing stones or tree roots. It is known as a "knifer."

Steam-grubber. Fowler & Co.

For deep stirring.

It may be called a renovating or reclaiming implement, and under all circumstances of its use is a powerful assistant in the matter of drainage in strong soils.

Price, £85.

Price.

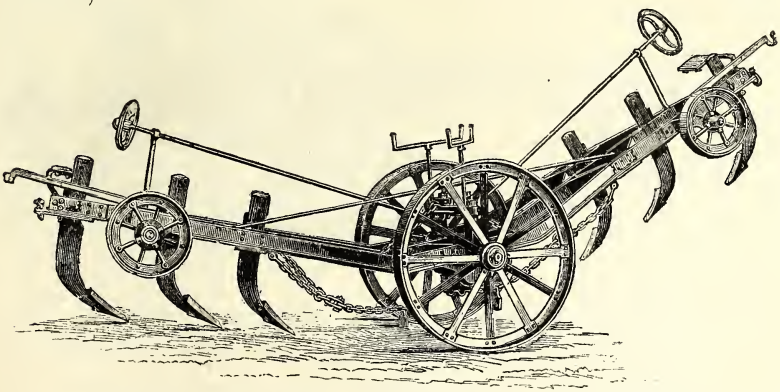


FIG. 85.—*Steam-grubber. John Fowler & Co., Leeds, England.*

The implement (Fig. 86) with 3 or 5 tines works deeply in the ground, lifts the soil, and leaves it loose. It has a

Steam-cultivator.

Steam culture. Implements.

strong flanged steel frame, shares of various widths, from 2″ up to 13″, and furnished with prongs to lift the soil. The tines rock on the frame, so that when the implement is reversed at each end of the field the points in work are depressed and the hinder one slightly raised.

Price of 5-tine implement, £45.

Steam-cultivator. J. & F. Howard.

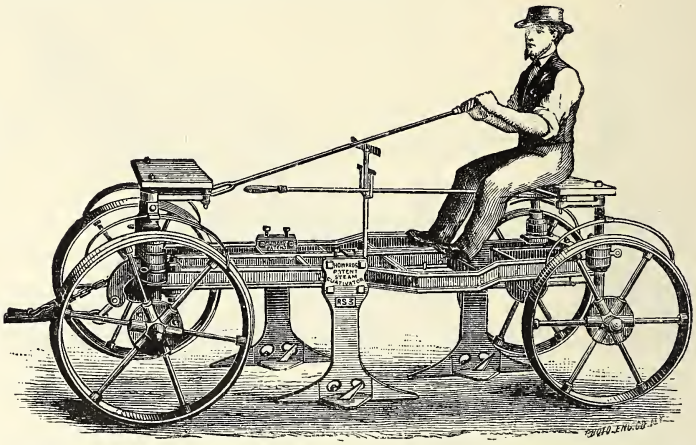


FIG. 86.—*Double-action steam-cultivator. James & Frederick Howard, Bedford, England.*

Turning cultivator. Fowler & Co.

The turning cultivator (Fig. 87) is adapted to be worked by all systems of steam machinery. It has a strong frame, carrying, according to circumstances, from 5 to 13 tines, and resting on three wheels, one of which is the steering-wheel. The axle of the two hind wheels is cranked, so that by its

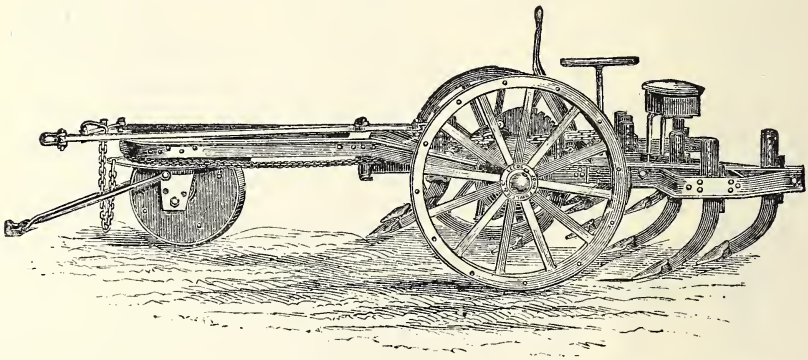


FIG. 87.—*Turning cultivator. John Fowler & Co., Leeds, England.*

being turned the frame is raised or lowered, and by this means the depth of penetration of the tines adjusted.

Mode of working.

The long end of a draft-bar or turning-lever is provided with two arms to which the two ends of the rope are attached. The arms are set at an angle for keeping the tail-

Steam culture. Implements.

rope clear of the implement. The lever itself is held by a vertical stud fixed to the frame considerably behind the steering-wheel. This position of the draft-stud gives the necessary liberty and power to the steering-wheel and enables it to lead the implement at almost any angle out of the line of the pulling-rope.

Turning cultivator. Fowler & Co. (Figure 87).

On the short end of the turning-lever is a chain communicating with a quadrant on the crank-axle, and as the lever is pulled round, the chain, acting on the quadrant, turns the axle, lifts the frame, and raises the tines out of the ground.

Mode of working.

The plan of operation is as follows: As soon as the cultivator is brought up to the headland, the reverse pull brings the lever around, turns the quadrant, rotates the bent axle, and lifts the tines out of the ground, in which position the cultivator frame is held up by a catch; when lifted the required height, the lever strikes against a stop, and the implement turns into new ground. The man, who never leaves his seat, releases the catch, the tines drop into the ground, and the implement is re-drawn across the field.

This description of the method of automatically lifting the tool and turning it on to the next bout will answer for the "turning harrow" and the "combined harrow and seeder" of the same makers (Figs. 88 and 90), and elsewhere described in this paper.

Its efficiency.

This, after the plow, is the most important and efficient implement of the series. Its size is only limited by the power of the engines, which are thus used up to their capability. It pulverizes the soil, working steadily to a uniform depth. The largest machines require but one man in attendance upon them. The engineer and rope porter boy have of course their duties. In turning round no additional labor whatever is required and scarcely any time is lost, while the implement, however wide, at once moves into new land, leaving small and regular headlands.

Attendance required.

Capacity for changes of function.

Ridging-bodies may be attached to the frame to throw up the land for seeding on ridges or for winter exposure to the air and to frost. The ridging-bodies are attached without taking away the tines, and both operations are done at the same time.

Price.

Price (steel), £81.

Turning harrow. (Figure 88).

The turning harrow (Fig. 88) is a medium between the ordinary steam-cultivator and steam-harrow, being less profound than the former but more effective than the latter.

It is fitted at will with either of two kinds of shares, a broad one for cutting the whole ground and a square-pointed tine for stirring the ground only.

Steam culture. Implements.

The instrument is in three pieces, so as to accommodate itself to uneven surfaces, and will take a breadth of 12′ to 15′. It is especially recommended for stirring, for spring crops, ground which has been deeply plowed the previous fall.

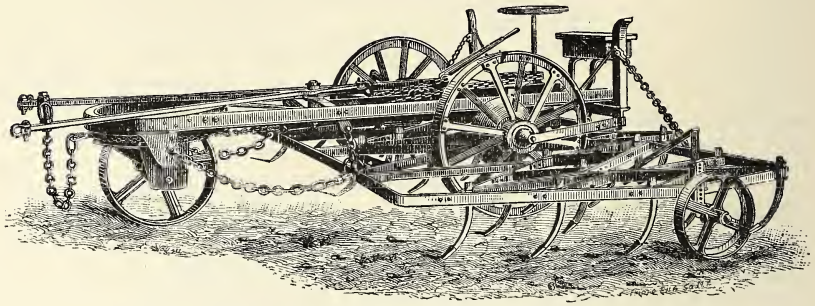


FIG. 88.—*Turning harrow. John Fowler & Co., Leeds, England.*

Turning harrow. Fowler & Co.

The steering-frame is adapted to take different harrows, from the lightest seed-harrow up to light cultivating tools, or it can be fitted with light ridging plows. It is lifted and turned in the same manner as described under *turning cultivator* (Fig. 87).

Three ridging-bodies can be put on the frame instead of the harrow, which is made of wrought iron and has welded sockets for the tines. A light harrow may be hung behind if desired.

Price.

Price, 10′ wide (steel), £88.

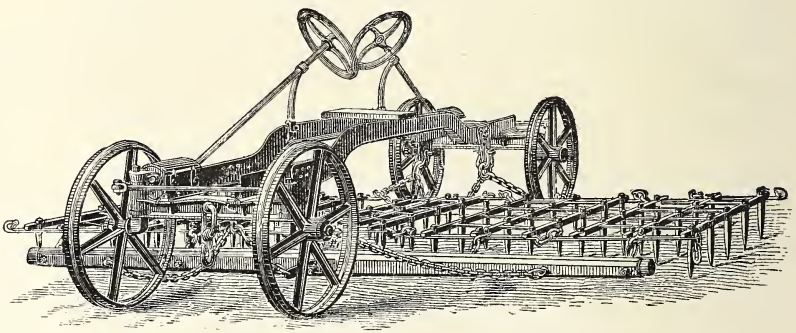


FIG. 89.—*Steam-harrow. John Fowler & Co., Leeds, England.*

Steam-harrow. Fowler & Co. Working capacity.

The ordinary steam-harrow (Fig. 89) covers a breadth of from 12′ to 18′, so that from 40 to 60 acres may be gone over in a day.

The harrow moves in either direction and can be driven at high speed. The under frames can be removed and rollers or clod-crushers substituted for them.

Price.

Price, 5-framed, £55.

Steam culture. Implements.

The machine (Fig. 90) has a light cultivator or heavy harrow in front of the seeding-colters and a light covering-harrow following the same. The seed-drill itself, even of the largest width, requires but so small a fraction of the power

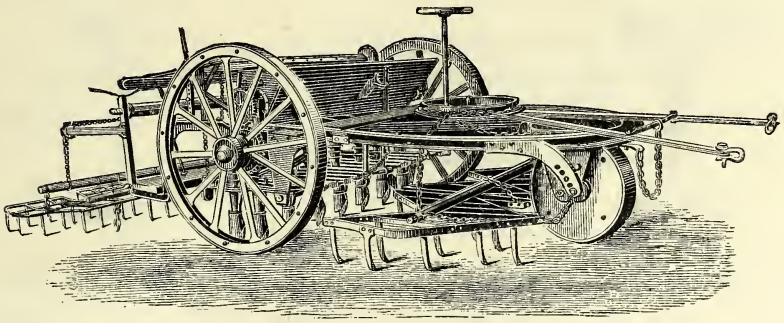


FIG. 90.—*Combined harrow and seeder. John Fowler & Co., Leeds, England.*

Steam harrow and seeder. Fowler & Co.

of the engines, that it has been combined with the harrows. The drill has a width of 9′. In turning around, the heavy harrows are lifted by the power of the engine, and the whole implement moves at once onto new ground. The automatic lifting and turning action is described in connection with the turning cultivator (Fig. 87).

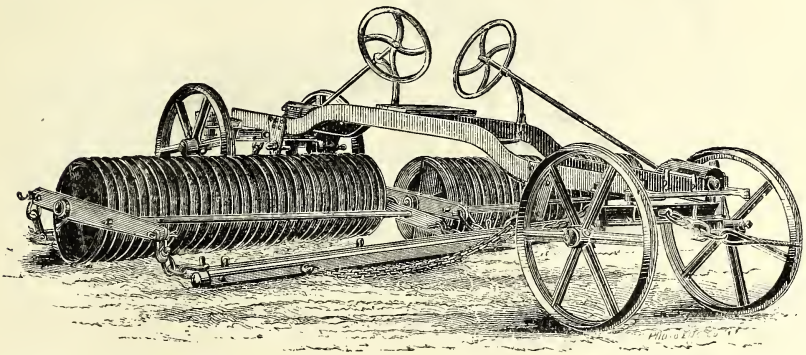


FIG. 91.—*Steam-roller. John Fowler & Co., Leeds, England.*

Steam-roller. Fowler & Co.

The implement Fig. 91 has a width of 15′, and may be fitted with any description of roller, smooth, corrugated, or sectional. The suspended frame is hinged in the middle and can be readily taken to pieces, so that in moving from field to field the two halves are pulled one behind the other, and pass conveniently along an ordinary or a farm road or through gateways.

Price.

Price of steerage-frame, £37; rollers, by weight, 12*s.* per cwt. (112 lbs.).

Steam culture. Implements.

The implement Fig. 92 is intended to cultivate newly reclaimed soil without tearing up the solid furrow slice and bringing the turfy matter to the top. It merely pulverizes the soil to a depth of 3″ or 4″ and is a substitute for the

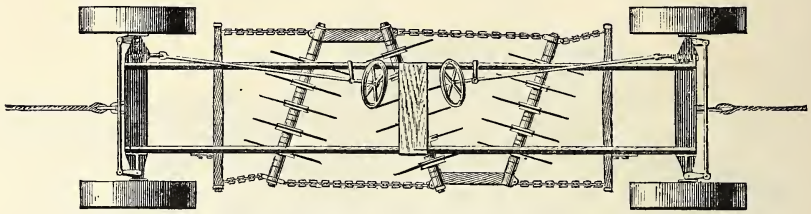


FIG. 92.—*Disking machine. John Fowler & Co., Leeds, England.*

Disking machine. Fowler & Co.

harrow, but leaves the turf at bottom to rot. It is principally used in reclaiming wild grass lands. This mode of preparing the surface for seed is becoming very popular and its effect is similar to that of our disk-harrow, now well known with us.

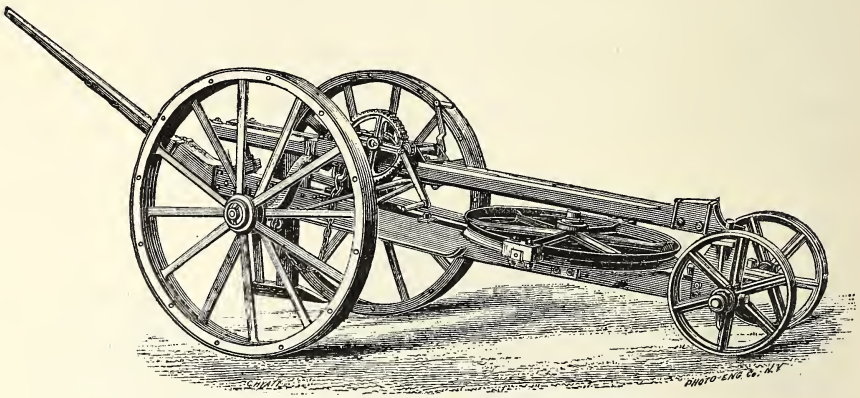


FIG. 93.—*Draining plow. John Fowler & Co., Leeds, England.*

Draining plow. Fowler & Co.

The steam draining-plow (Fig. 93) is another implement adapted to be worked by the winding engine and rope. It is used either as a mole-plow or to put in pipes, and may be worked to a depth of 42″. When the wire rope passes over the pulley the speed of the plow, at great depths, is only half what it would be were the wire simply connected to the front of the carriage, the speed of the engine remaining the same.

Price.

Price, £50.

Reclamation plow. (Figure 94).

The reclamation plow (Fig. 94) is designed for the first breaking of stony land to reduce it to cultivation, and has been largely used for several years past in Sutherlandshire, Scotland.

Steam culture. Implements.

The plow is preceded by steel disks, which lift the share over stones or other obstructions, so as not to break it or the moldboard. The plow will turn a furrow 2′ wide and 15″ deep completely over, an operation materially assisted

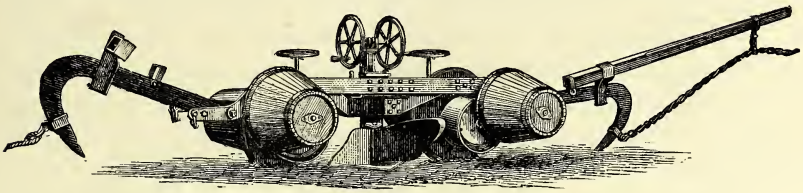


FIG. 94—*Reclamation plow. John Fowler & Co., Leeds, England.*

Reclamation plow. Fowler & Co.

by the rollers, which catch the furrow-slice at the moment of leaving the moldboard. The stones which have been passed over are torn out by the hook-tine which comes behind the plow. They are then removed by men with teams and stone-boats. The tine thoroughly subsoils the land to a depth of 2′, and materially assists the drainage of the soil.

Summary of the question of steam-cultivation.

Summary of the question of steam-cultivation.

As to the merits of the matter, take the following statement embracing the results of the most diligent study of the question as it concerns agriculture:

Deep culture.

1. Deep cultivation is the great point, and very deep plowing injurious.

Exposure of the soil.

2. Exposure of land to the weather and its cultivation only when dry are essential to success.

Avoidance of poaching the soil.

3. By keeping horses from treading the land only half the labor will be required in the term of years.

Even temperature of the soil.

4. By deep cultivation there is a greater certainty of getting crops into a healthy condition, the result of an even temperature of the soil, the temperature of the air being of less moment to the healthy state of the plants than the temperature of the soil itself.

Early development of the plants.

5. The early development of the plants is of vital importance to their future growth.

Encouragement of deep rooting.

6. In heavy land, crops such as clover, which has a large amount of roots, should be grown, to keep the soil in proper condition and mechanical state.

Abundant leafage of growing crops.

7. In light soils the surface should be continually covered by crops bearing as much leaf as possible, to convey to the land from the atmosphere its manuring properties.

Cultivators.

The cultivator has various forms, and is better known in England under its name of "horse-hoe," which fairly expresses its purpose and application. The French implements of this order are largely copies of the English, not of the American. The English and French crops and systems of farming more nearly resemble each other than either does the American.

French horse-hoe. Delahaie-Tailleur.

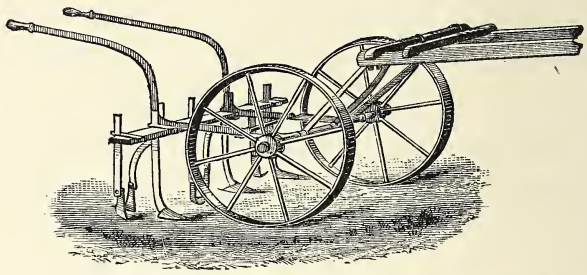


FIG. 95.—*French horse-hoe. Delahaie-Tailleur & Bajac, Liancourt, France.*

European use of hoe in drilled growing crops.

The English horse-hoe, for instance, for cultivating wheat, has hardly any analogy to any implement with us, but is used in France. In the damper climate of Europe some crops grow better on ridges, or ridged up, than on a level, while in our drier and hotter climate flat culture is the better. The single-shovel plow has, therefore, been pretty much discarded in tending corn, and the double shovel or cultivator used instead.

Hoeing wheat.

The implement shown in Fig. 95 is intended to follow drilled wheat, the hoes being carefully adjusted to the proper relative distance in accordance with the shares of the drill. The whole row of hoes is lifted or depressed by the movement of a single lever without stopping the machine.

French horse-hoe. (Figure 96.) Meixmoron de Dombasle.

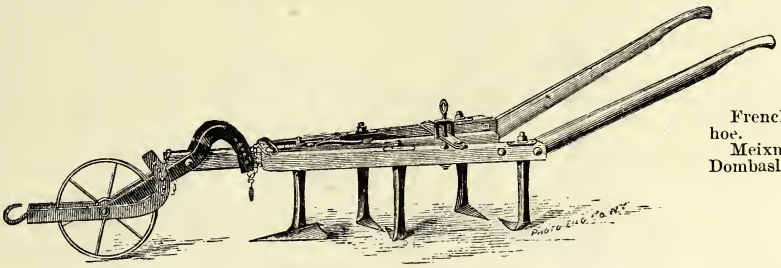
Fig. 96 is a French horse-hoe exhibited by Meixmoron de Dombasle, of Nancy. It is a lighter form, an approximation to the American, except in the shape of the hoes, which follows the English. The wheel in front regulates the depth, and the double adjustment by means of the perforated bars and pins gives command of the level or inclination of the frame. The latter is adjustable for different widths. The price is 60 fr., and the weight 60 kilos.

Besides the cultivators and horse-hoes, the duty of which is expressed by their names, they being intended to stir the

Cultivators.

earth and kill weeds in growing crops, and generally drawn by one horse, being light tools, there is a class of similarly appearing implements, but of much larger size and intended for a different duty. These are known by various English names, being almost exclusively British inventions: "Scari-

A class of larger soil-stirrers.

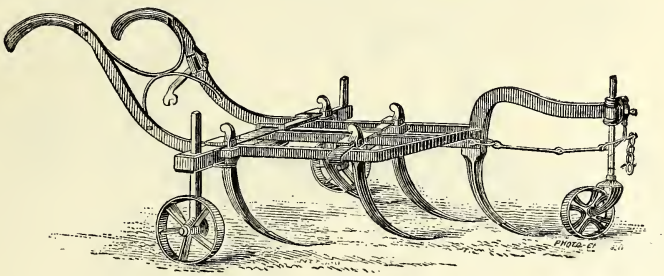


French horse-hoe. Meixmoron de Dombasle.

FIG. 96.—*French horse-hoe. Meixmoron de Dombasle, Nancy, France.*

fiers," "extirpators," etc. Their purpose is to stir the ground deeply to improve its tilth. While there was formerly much more variety in their shape, they have now generally a triangular frame. The differences between the machines of the different nations or manufacturers are principally in the adjustments or in the form of the teeth.

Scarifiers and extirpators.



French extirpator. Bodin.

FIG. 97.—*Extirpateur. E. Bodin, Rennes, France.*

The French *extirpateur* exhibited by Bodin has hooking teeth, five in number, in a triangular frame supported on three wheels and with a pair of handles. The standard of the lead wheel is adjustable to regulate the depth of penetration. The price is 175 fr., and the weight 160 kilos.

Description.

Price.

A large machine exhibited in the English section by Corbett & Peele, of Shrewsbury, has four strong wheels carrying a wrought-iron frame, within which iron cross-bars are fixed. The tines are of wrought iron with steel points, and are attached to the cross-bars with clips and wedges at any distance apart, and as numerous as may be desired. The depth of working is regulated by a lever; this commands the bar on whose ends the rear wheels are journaled. The price of the 9-tine cultivator is £11. The tines differ in shape from those last described.

Chltivator. Corbett & Peele. (Figure 98.)

Description.

Price.

Cultivators.

The *scarificateur-extirpateur* of Breloux, of Nevers (*Nièvre*), is an efficient implement when sufficient power is applied. Seven shares are fixed in the triangular iron frame, the front angle of which has a goose-neck, in which the stand-

English cultivator. Corbett & Peele.

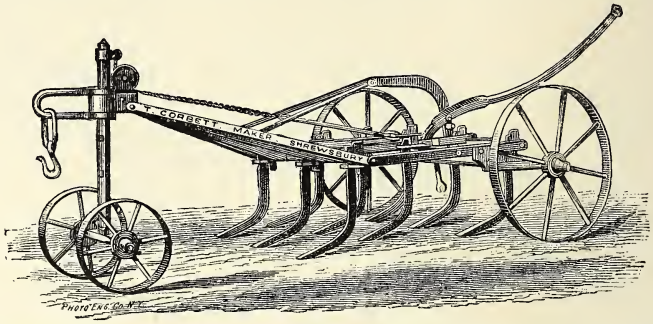


FIG. 98.—*English lever-cultivator. Corbett & Peele, Shrewsbury, England.*

Breloux's

ard of the caster-wheel is placed. A single movement of the lever raises or depresses the frame at all points equally, so as to keep it in parallelism with the soil. The shares, it will be seen, differ from the other machines of its class just

Scarifier.

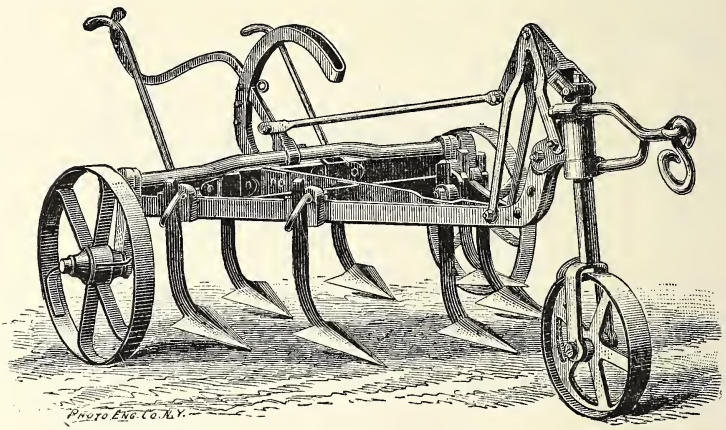


FIG. 99.—*Scarifier. B. Breloux, Nevers, France.*

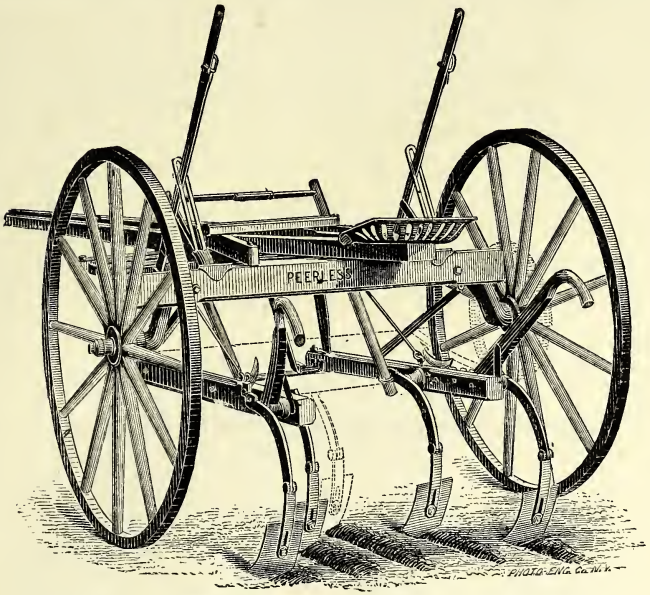
mentioned. It requires great power, and cultivates rather than plows. It resembles one of the series of machines used with the traction engine and wire rope. (See under "Steam Plow," *supra.*)

Riding cultivator. Deere & Co. (Figure 100.)

The "Peerless" walking or riding cultivator, made by Deere & Co., of Moline, Ill., was the only implement of its class exhibited in the Exposition at Paris, and attracted a great deal of attention. Though so common in the United States, it is a type of machine unlike anything in Europe, except as to the few that have been imported from America.

Cultivators.

Their use being principally confined to the culture of corn on a large scale, it is not, perhaps, singular that they are comparatively unknown in France, where the culture of corn is in drills for fodder, and in limited areas. In Northern Italy,

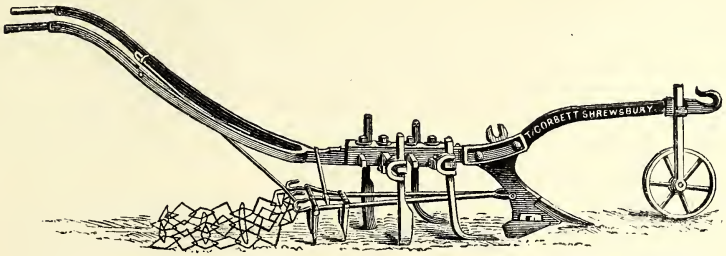


Riding cultivator "Peerless." Deere & Co.

FIG. 100.—*"Peerless" cultivator. Deere & Co., Moline, Ill.*

Corn in the valley of the Po.

however, the fields of corn are very extensive, and stretch for miles alongside of the railway from Padua to Milan, and thousands of acres of tall corn between the rows of mulberry trees give the landscape an appearance very familiar to a Western man. The absence of hedges or fences, making the fields of adjacent farmers appear continuous, adds to the illusion.



Horse-hoe and grubber. Corbett & Peele.

FIG. 101.—*5-tine horse-hoe and grubber. Corbett & Peele, Shrewsbury, England.*

Description of "Peerless" cultivator.

The operation of the machine—the action of the pair of double-shovel plows being controlled by the feet in riding and by the hands in walking, and the lever adjustment of the plows for depth and for the suspension of the shovels above

Cultivators.

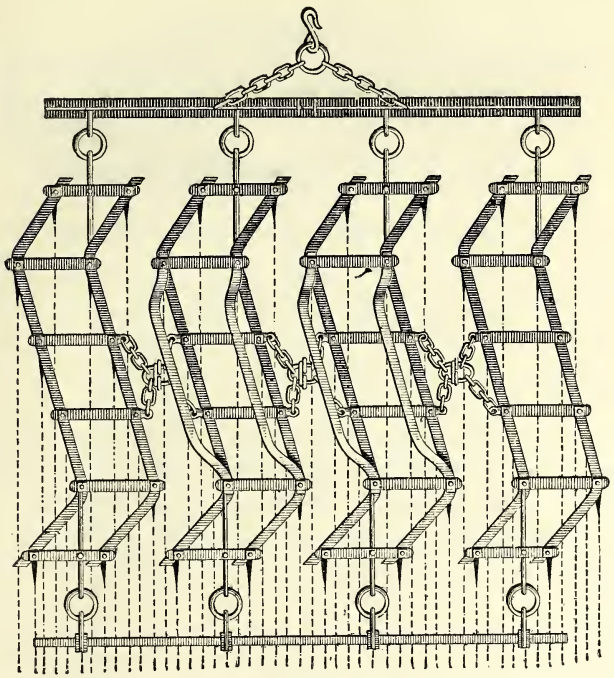
the ground for turning or for transportation, and the use of a fifth or center shovel when seeding, do not need to be more than referred to.

English horse-hoe and grubber. (Figure 101.)

Fig. 101 shows an English single-row horse-hoe made for cultivating root crops in drills. The implements are adaptable for either ridge or flat cultivation. The share with lateral wings precedes, and is followed by cultivator-shares; these by harrow-tines; and lastly by a chain-harrow.

A somewhat larger variety of harrows is found in France and in England than prevails with us, and tools of this order considered worthy of exhibition are almost exclusively of iron. A common harrow is very easily made—the frame of A-shape or rectangular, holes for the teeth being bored with an auger and burnt square with one of the teeth heated to redness. Such primitive instruments, however, are not sent to grand exhibitions, and the agricultural implements

Large variety in Europe.



French flexible harrow. Puzenat.

FIG. 102.—*Flexible harrow. É. Puzenat, Bourbon-Lancy, France.*

shown in Paris in 1878 or in Philadelphia in 1876 were much above the average of the ordinary country supply.

The harrow with jointed sections is the form most largely exhibited, but simpler and cheaper forms generally prevail.

The jointed-sections harrow.

The harrow Fig. 102 may be taken as representative of a large number which differ but in minor details.

This harrow is made by Émile Puzenat, of Bourbon-Lancy

Harrows. Puzenat's harrow. (Figure 102.)

(*Seine-et-Loire*), of the following sizes, medium strength for ordinary soils:

Prices.

	Francs.
3 sections, 36 teeth, 1.60 meter wide, 67 kilos weight	60
4 sections, 48 teeth, 2.12 meters wide, 90 kilos weight	80
5 sections, 60 teeth, 2.66 meters wide, 112 kilos weight	100
6 sections, 72 teeth, 3.20 meters wide, 135 kilos weight	125

All the harrows of this class agree in being drawn by a single swing-bar, to which the sections are attached at an equal distance, the obliquity of the frames relatively to the line of draft causing the harrow-tines to track in the inter-

Harrows with handles.

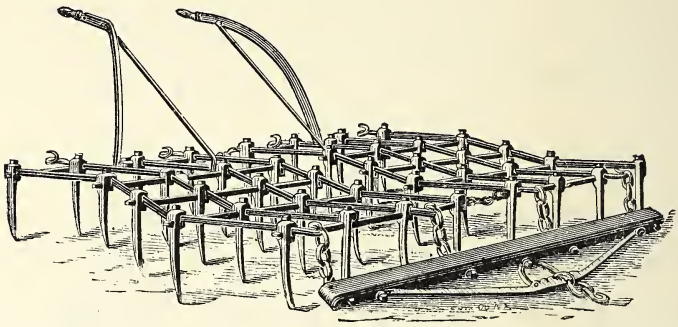


FIG. 103.—*Harrow with handles. Picksley, Sims, & Co., Leigh, England.*

vals of each other. The equalizing-bar at the rear preserves the regular distance of the sections, and the middle sections have runners, upon which the implement may be drawn when reversed, the side sections being laid over upon the middle ones.

The same general shape of harrow sections is found in the English "harrow with handles" made by Picksley, Sims, & Co., of Leigh, near Manchester. The zigzag bars (Fig. 103) and the transverse bar of the frame pass through slots in the head of the tine, and are clamped by a screw. (Fig. 104.) A heavy harrow of this description approaches in appearance and efficiency the implement known as a scarificator, and the handles enable the workman, by pressing upon or lifting them, to increase or decrease the depth of penetration. The harrow has two sections, with chain connection to each other and to the swing-bar; the width of tilth is 2.135 meters; each section has 40 teeth, 0.250 meter long; and the whole, with handles and swing-bar, complete, weighs 157 kilos. Price, with handles, 153 fr.; without handles, 138 fr.

Picksley, Sims, & Co.

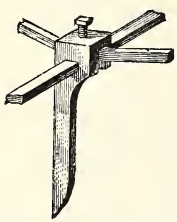


FIG. 104.—*Harrow tine and frame. Picksley, Sims, & Co., Leigh, England.*

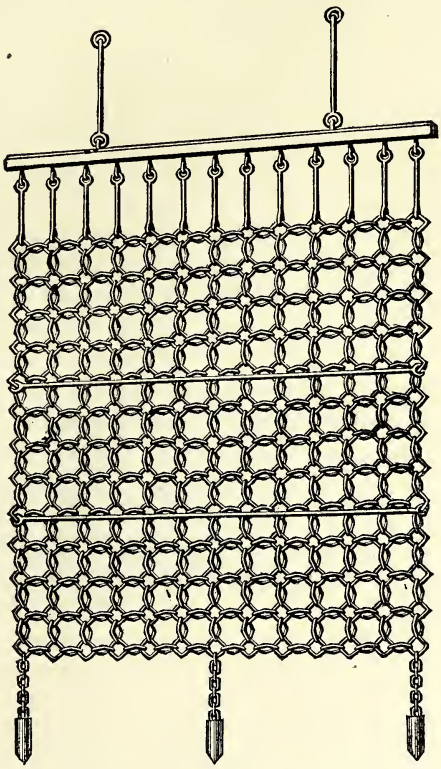
Prices.

Harrows.

Harrows were exhibited in the English and French sections made on the "coat-of-mail" principle of connected links.

Such implements are extremely flexible, and will smooth a surface satisfactorily when the ground is in proper order, but will not level it so well as the harrow with rigid frame, or made of an assemblage of frames individually rigid. The latter class will drag protuberant portions and clods into hollows. Land long cultivated and well plowed may be sufficiently leveled by the "chain-harrow," but in newer ground, formerly wooded, the frame-harrow will be preferred. We have, however, a vast scope of land innocent of stumps.

Chain-harrows.



Flexible chain-harrow. Picksley, Sims, & Co.

FIG. 105.—*Chain-harrow. Picksley, Sims, & Co., Leigh, England.*

The sizes and prices are as follows:

Sizes and prices.

Width.	Length.	Price, extra heavy.	Price, ordinary.
Meters.	*Meters.*	*Francs.*	*Francs.*
1.52	2.29	56	50
1.83	2.29	69	63
2.29	2.29	81	75
2.44	2.29	94	88

Harrows.

It is particularly recommended for covering seed and preparing the surface for permanent meadow.

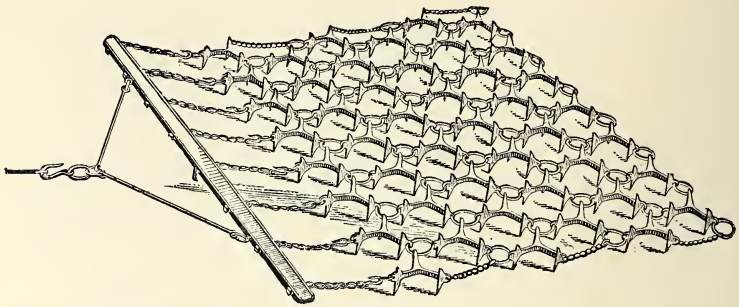


FIG. 106.—*Flexible chain-harrow. James & Frederick Howard, Bedford, England.*

Howard's flexible chain-harrow. Bodin.

The chain-harrow invented by Howard, of England, and exhibited by Bodin, of Trois-Croix, Rennes, France, is made of small triangular sections, each of which has two feet which form the tines. The other angle is short, and is rove upon a ring, which unites three adjacent sections. The harrow is made larger or smaller by varying the number of the sections; a large size, for two horses, covering 3 square meters of surface, weighing 135 kilos, is sold at 126 fr. A smaller size covers 2.38 meters, weighs 77 kilos, and costs 86 fr.

The harrow may travel upon one or other of its faces, and in either direction relatively to the trend of the teeth. By these means a more or less energetic action may be secured, the depth of penetration being varied.

Norwegian harrow.

Some other harrows had peculiar features, such as the Norwegian harrow with rotating spiked rollers, and triangular-framed harrows, with wheels to limit the depth of penetration of the tines.

Substitution of shares and disks for teeth.

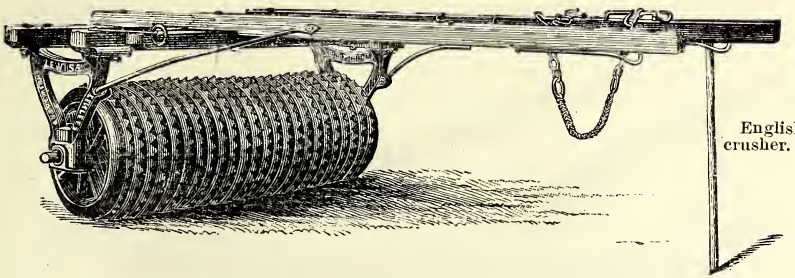
In the United States the principal late improvements in harrows have been in the way of substituting cutters or disks for tines, so that the implement may cut the clods, instead of merely striking or displacing them. No land harrows were exhibited at the Paris Exposition from America; but those we might have sent would have been very much regarded, for but little has been done in Europe in our line of improved harrows, the "disk" harrow, for instance, and those forms which have shares like cultivators; in fact, the latter varieties are but cultivators on a large scale, doing all that the harrow can do and much more. The harrow with disks or cutters is especially useful in harrowing sod ground after being turned by the plow.

Greater efficiency.

The farm-roller is much more extensively and frequently used in England and France than in the United States. It is, perhaps, also more necessary, for plowing frequently goes on in all weathers, wet or dry, and ground is made cloddy by being plowed with the water in it. The use of the roller is, however, rapidly extending with us, and very properly. More extensive use in Europe.

The variety of rollers at the Exposition was very great, but most of the forms are familiar to us—the long smooth roller; the same made of a number of sections on a common axis; the skeleton roller, made of an open cylinder, with bars having intervals; the roller in two sections, one a little in advance of the other, and their tracks just lapping; rollers with corrugated faces, and others with a series of sections like wheels slipped on to a common axis, and having faces (or "treads") of concave or convex forms, to give a corrugated effect to the combination. Variety at the Exposition.

Rollers with ridge-faces are recommended for replanting wheat, vetches, or other plants thrown out by the frost; for killing worms, which infest some clayey soils and render it still more tenacious; and for breaking clods. Ridge-faced rollers.



English clod-crusher.

FIG. 107.—*Clod-crusher. Lowcock & Barr, Shrewsbury, England.*

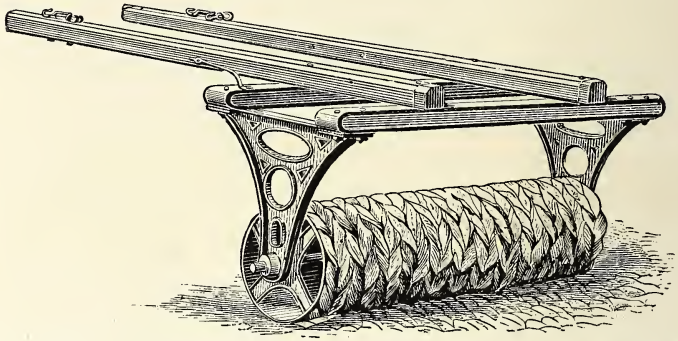
The clod-crusher exhibited by Lowcock & Barr, of Shrewsbury, England, has a series of disks, alternately toothed and plain, the former having the larger diameter and the latter the greater width of face. As both touch the ground at work, they rotate in different times. The roller has 48 disks in a length of 1.83 meter, and by the projection of the angles of the larger disks present effective breaking edges to the clods. Lowcock & Barr.

The sizes vary from a length of 1.575 meter, diameter 0.355 meter, price 196.75 fr., to a length of 2.135 meters, diameter 0.660 meter, price 387.50 fr. Sizes and prices.

Land-rollers.

Clod-crushers on the "Crosskill" principle afford the principal novelties. Besides the one just cited, is another English one by Picksley, Sims, & Co., of Leigh, near Manchester. It aims to give a more equal pressure, with slight protuberances, which render this class of implements so much more effective than the plain-faced roller. As in the

"Excelsior" clod-crusher.



Picksley, Sims, & Co.

FIG. 108.—*"Excelsior" clod-crusher. Picksley, Sims, & Co., Leigh, England.*

other cases, the disks rotate separately; the knobs do not penetrate so far, but leave moderate impressions, which, however, are sufficient, when rolling after seeding wheat, to prevent the collection of clover or grass seed in the drill-mark where the grain is deposited. The object has been to imitate the effect of sheep's feet, so useful in replanting wheat ejected by winter frost.

Advantages.

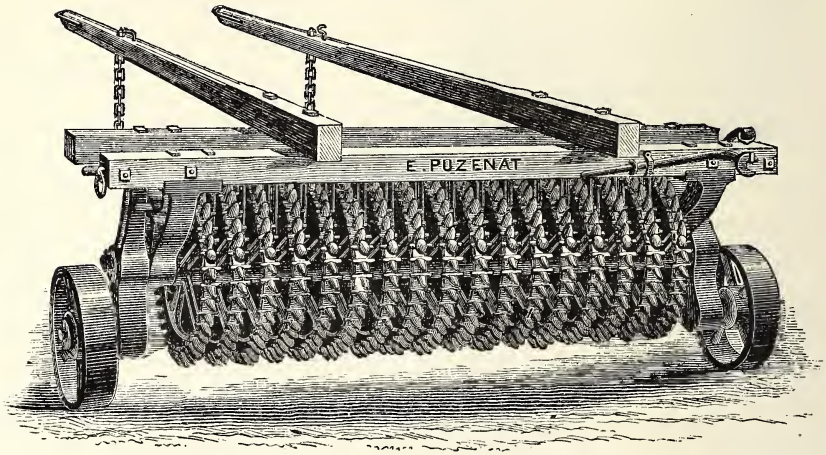


FIG. 109.—*Crosskill clod-crusher. Émile Puzenat, Bourbon-Lancy, France.*

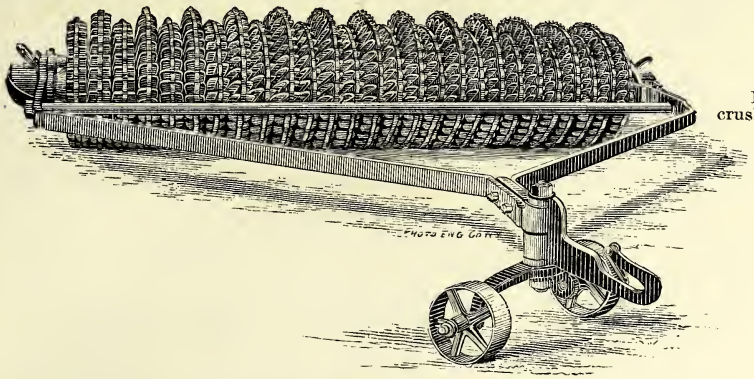
Sizes and prices.

These rollers are made of various sizes: Widths of from 1.525 meter to 2.570 meters; diameters, 0.458 to 0.660 meter; and prices from 231 to 528 fr.

Land-rollers.

Fig. 109 is the Crosskill clod-crusher, as made and exhibited by Émile Puzenat, of Bourbon-Lancy (*Seine-et-Loire*), France. It has independent toothed disks, with intervals, and is furnished with either shafts or tongues, according to size. It is mounted on small wheels to enable it to be readily moved from place to place, and by a simple key the attendant can readily, without assistance, raise or lower the wheels, to put it in working or traveling condition, respectively.

Puzenat (Figure 109).



French clod-crusher.

FIG. 110.—*Clod crusher and compressor. Demarly Père & Fils & Fouquart, Origny-Sainte-Benoîte, France.*

Demarly.

Fig. 110 shows an implement which is designed as an improvement on others of its class, and was exhibited by the manufacturers, Demarly Père & Fils & Fouquart, of Origny-Sainte-Benoîte (*Aisne*), France. Besides the unequal sizes of the roller sections, in alternate order, they have an ability to slip transversely upon the axis. By this means, though of varying size, they may present themselves in straight line upon a level surface; either may lift in yielding to a large clod; and, as the surface rotation of each is equal, the rate of motion of the larger ones on the common axis is slower than that of the smaller rings, and, therefore, any clods getting between them are ground to powder, and the spaces between them are not choked.

Operation.

No American rollers exhibited.

There were no American rollers at the Paris Exposition, and we could have added little or nothing to the show in this line.

Under this general term are included machines for sowing seed or fertilizers, either in drills or broadcast. Such were exhibited from France, the United States, England, Italy, Sweden, Denmark, and Canada. The first four named were represented at the official trials of seeding and fertilizing machines held at Petit-Bourg (*Seine-et-Oise*), July 29, 1878.

Trials at Petit-Bourg.

The trial took place in the afternoon and upon ground turned up during the plow trial in the morning of the same day.

Eleven exhibitors entered the lists, but there were many machines shown in the buildings on the Champ de Mars not in the field at the competitive trials.

Entries for the trials.

Entries at the grain and fertilizer drill trials.

Albaret & Co	Liancourt (*Oise*)	France	Grain-drill.
Derosme	Bavay (*Nord*)	France	Do.
Farmers' Friend Manufacturing Company.	Dayton, Ohio	United States	Grain and fertilizer drill.
Gautreau	Dourdan (*Seine-et-Oise*)	France	Seeder.
Hurtu	Nangis (*Seine-et-Marne*)	France	Seeders.
Josse	Ormesson (*Seine-et-Oise*)	France	Fertilizer-sower.
Leclèrc	Rouen (*Seine Inférieure*)	France	Seeder.
Marino-Tardioli	Arceria	Italy	Do.
Nobili, F	Florence	Italy	Grain and fertilizer seeder.
Robillard & Maréchal	Arras (*Pas-de-Calais*)	France	Do.
Smyth & Sons	Peasenhall	England	Beet-seeders.

Grain-drills.

Comparison of the American with European grain-drills.

The American drill is quite a different affair from the English or French implement for the same purpose, and is but little known in Europe. Its comparative simplicity and lightness, with equal if not superior efficiency, made it an object of great attention both at Philadelphia in 1876 and at Paris in 1878. Mr. John Coleman, of the Royal Agricultural Society of England, the president of the group jury in Philadelphia, and the English member of the class jury 51 in Paris, published his opinion that the American was much the superior implement.

John Coleman.

The "force-feed" of the American drills and "cup-feed" of the English.

The best American drills have systems of "force-feed" instead of depending upon revolving cups or merely upon the gravity of the grain, which is variable as the hopper becomes gradually emptied. All the English drills, and most of the French, have a complicated system of short sheet-metal conductors which lead the grain to the shovels;

Grain-drills. Conductors.

the American drills employ a caoutchouc tubular conductor. The latter feature was noticed on one French drill made by Gautreau, of Dourdan (*Seine-et-Oise*). The larger-size drill, however, of this manufacturer has the system of rattling sheet-metal conductors.

The shovels of the European and American drills compared,

One very distinct point of difference between the European grain-drills and the American is found in the shovels and the mode of forcing them into the soil, so as to make furrows for the seed which drops behind them. The European shovels, for the English and French agree in this, are nearly vertical, trailing a little backward in fact, and are forced into the soil by means of a weighted lever of the second order attached to each. One or more cast-iron weights are placed on the end of the lever, according to the hardness of the ground, and the result is no small addition to the weight of the machine, needless were the shovels made "hooking" (so called), so as to draw into the soil, the point ranging forward in the manner of the ordinary plow, which keeps itself in the ground by virtue of the mode of presentation of its point. To make the matter clearer, a cut is appended of the "Farmers' Friend" drill, which was exhibited both in Philadelphia and in Paris. It must be mentioned in fairness that the backward inclination of the shovels, in Gautreau's drill for instance, is designed to prevent the catching and trailing of weeds and manure, incident to others having the hook presentation (*ayant la forme du crochet*).

as shown in Figures 111 and 113.

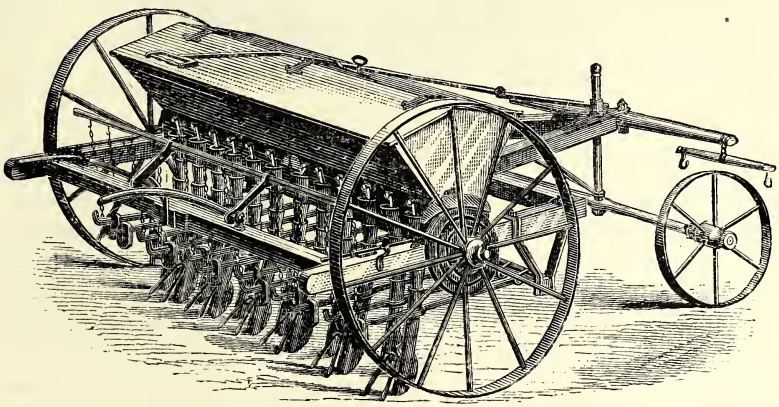


FIG. 111.—*French grain-drill. T. Gautreau, Dourdan, France.*

French grain-drill.

A large number of grain-drills were exhibited from England and France, also some from Sweden and other parts of the Continent outside of France. The Gautreau drill (Fig. 111) may be taken as fairly representative, and a com-

Gautreau.

Grain-drills.

parison of it with the "Farmers' Friend" (Fig. 113) will illustrate the principal differences between the approved machines on the respective sides of the Atlantic.

Gautreau drill (Figure 111).

The Gautreau drill (Fig. 111) has a fore carriage (*avant-train*), which is controlled by the workmen at the rear of the machine, and serves to guide the drill. The steering-lever is seen trailing backward and resting on the top of the seed-box. In the English drills this duty is frequently allotted to a man in advance of the hopper-box, walking between it and the fore carriage, as shown in the illustration of the grain-drill of Smyth & Sons, of Peasenhall, Suffolk, England (Figure 112).

English grain-drill. Smyth & Sons.

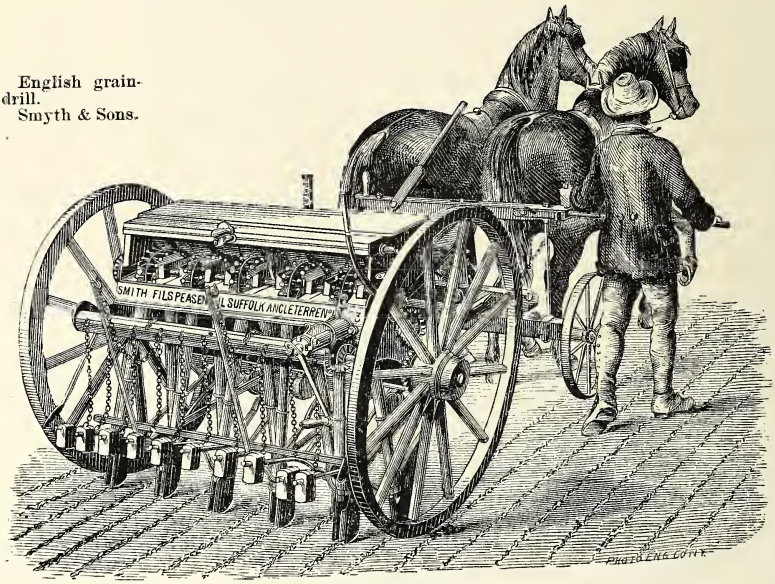


FIG. 112.—*Grain-drill. James Smyth & Sons, Peasenhall, England.*

Mode of working.

The man grasps an extension-bar extending laterally from the upper member of the fore carriage, and the latter is rotated on its vertical pivot by the horizontal movement of the bar, so as to deflect the course of the carriage to the right or left. Thus the man is able to keep the course perfectly straight. Great care is exercised in this respect, as a horse-hoe is expected to follow in due time to cultivate between the rows of plants, and any wobbling in the line must either be followed by the gang of hoes or the rows of plants hoed up where the irregularity occurs.

In the Gautreau drill each shovel of the gang is independent and their distance apart may be varied within certain limits. The whole gang is lifted out of the ground by a single motion, or lowered into working position, by means

Grain-drills. French grain-drill, Gautreau. (Figure 111.)

of handles; in some cases the shovels being in two gangs, half on each side, so that one-half may be lifted out of work in finishing up a narrow land or on the edge of a field. Plowing in narrow lands is much more common in Europe than with us, as excess of rain is there more frequent. In the implement shown in Fig. 111 any one of the shovels is thrown out of work by detaching the hook of its suspension-chain from the lifter-rod, and attaching the hook to the stud on the rear of the hopper, at the same time stopping by the little slide the seed-hole corresponding. The seed passing down the conductor is dropped in the furrow at the rear of the shovel, and is covered by means of the two prongs which trail at the rear.

American grain-drill, "Farmers' Friend."

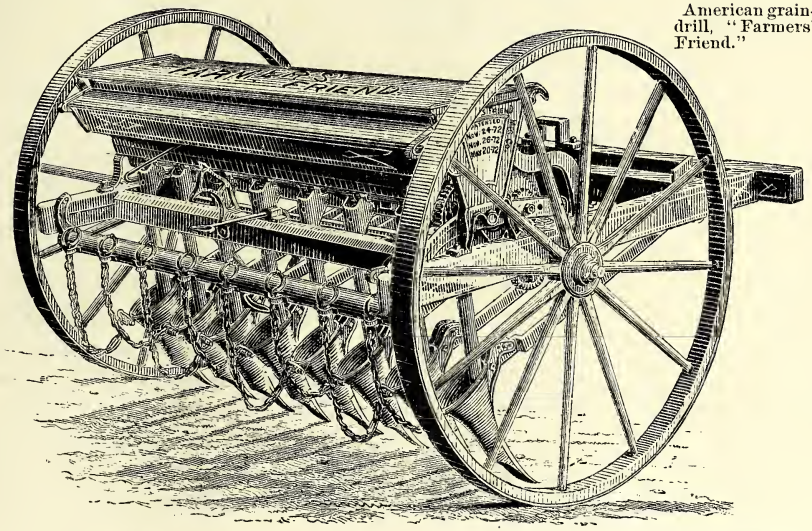


FIG. 113.—*Kuhn's grain-drill. Farmers' Friend Manufacturing Company, Dayton, Ohio.*

The distributor in the hopper is worked by gearing from the ground-wheels and is thrown into or out of action by a pinion of engagement worked by a handle.

A comparison of the Gautreau grain-drill with any representative American drill will reveal great and important differences. Some of these have been mentioned, but others as important have not been referred to.

American drills exhibited.

The American grain-drills in Paris were from the Farmers' Friend Manufacturing Company, Dayton, Ohio; J. W. Stoddard & Co., Dayton, Ohio; Bickford & Huffman, Macedon, N. Y.

Gold medal.

The "Farmer's Friend" drill, Figure 113, to which the only gold medal for grain-drills was awarded in Paris, is

Grain-drills.

selected to illustrate some of the points of difference between the American and European drills. It has several features not found in the English and French sections:

Features of the American drills:

Cone-gearing.

Cone-gearing or analogous device for regulating the quantity sown per acre; shiftable during the motion of the team and operated without loose parts.

Force-feed.

Force-feed for positively removing seed from the hopper in regulated quantity and dropping it into the conductor.

Rear-shifter.

A *rear-shifter* for throwing the shovels into one or two gangs, the latter known as "zigzagging the hoes."

Spring-shovel.

Another American device is the *spring-shovel*, which yields to obstructions and flies back into place when the obstruction is passed. A substitute device, also American it is believed, is the *break-pin* on the hoe, which allows it to rotate rearwardly and pass an obstruction, the hoe being then reset and a new pin placed. The object is to confine the breakage to a mere wooden pin, which is easily replaced from a supply carried in the box.

Break-pin.

The last-mentioned features are of course more particularly useful in new ground and in soils infested with large stones or roots.

Other attachments.

The simultaneous throwing of all the shovels into or out of action, the fertilizer and grass-seed attachments, and the "surveyor" for indicating the area of ground passed over are found in grain-drills on both sides of the Atlantic.

Features of European drills:

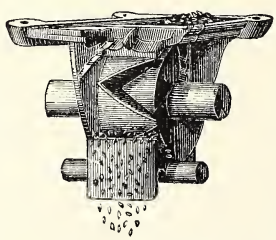
Another form of grain-drill made by Gautreau exhibited very clearly several customary European features:

Fore carriage.

The *fore carriage;* its horizontal bar with handles for the operator, walking on either side upon the last bout sown; as in Smyth's drill, Fig. 112.

Seed cups.

The *revolving cups* in the hopper, a series on each side of a wheel, revolving in the grain and discharging right and left into spouts which connect with the shovels in two gangs. (See Fig. 112.)



Force-feed of "Farmers' Friend."

FIG. 114.—*Force-feed of "Farmers' Friend" drill.*

In no respect is the difference between the American and the European grain-drills more marked than in the matter of the feed.

Force-feeds of various kinds are found in all the best American drills, and the European almost all follow the design of the old Spanish *noria*, in fact of the "wheel at the cistern" spoken of in the book of *Ecclesiastes.*

In the form of American force-feed shown in Fig. 114 the

wheel or distributor is represented with a section of the cup in which it revolves removed so that its construction and operation can be more fully understood. It has on its surface eight zigzag ribs, which form as many cavities, in which the grain is carried out by the revolutions of the wheel. These oblique ribs work in opposite directions, but act consecutively to push the grain towards the mouth of the cup.

Grain-drills. Force-feed of American drills.

A noticeable feature of variation in the European and American methods is in the apparatus for changing the feed or quantity of seed sown. This, in Gautreau's French drill, consists of a cog-wheel on the axle, one on the axis of the seed-wheels and a shiftable connection between the two.

Apparatus for changing feed.

Gautreau's French drill.

It is shown more clearly in the drawing of the parts involved detached (Fig. 115).

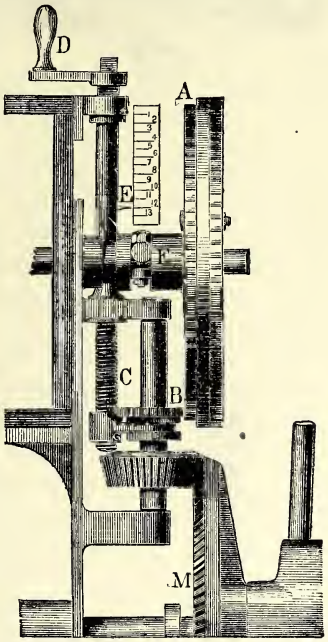


FIG. 115.—*Shiftable feed-movement of Gautreau's grain-drill.*

Shifting-feed movement.

On one of the ground-wheels is a bevel-wheel, M, which engages a bevel-pinion, on the axis of which is a cog-wheel, B, capable of being slipped vertically on its spline-shaft as the screw C is rotated by the handle D. The wheel A has on its face 12 concentric circles of teeth, having the same pitch but differing in diameter, and the pinion B engages with either, as it is vertically adjusted. B having, say, a constant rate of rotation, it will impart to F a motion whose rate will depend upon the distance of B from the axis of rotation of A.

The pointer E, attached below to the fork G, indicates against an index-plate the position of the pinion B relatively to the gears on the face of the wheel A; and each of the numbers on the index, by reference to a table, will show the quantity of grain sown per hectare at the given adjustment.

Description of operations.

It may be mentioned also that the Gautreau drill, like many others made in France and England, has seed-boxes articulated to the axles so as to be capable of inclination forward or backward in ascending or descending hills, or made vertical on the level. This is presumably to insure proper action of the feed-cups, and is unnecessary with the

Inclinable seed-box.

Grain-drills.

force-feed American drills. It has, however, a certain value in tipping the seed-box when it is required to be emptied.

American change-wheel arrangement.

In apposition to this the "Farmers' Friend" change-wheel arrangement may be shown.

The different change-wheels form a cone, which is shown with a section of the frame and all parts in connection with it. It is between two gear-wheels, the lower one of which is on the main shaft of the drill, and the upper one on the shaft that carries the feeder. To make a change the lever is pressed down in the rear, which unlocks the ratchet in front and raises the cone, when the wheel on the main shaft is moved by a lever into the wheel of the cone that will sow the desired quantity, which is indicated by a notched plate under the end of the lever. The result of this change makes the wheel on the feed-shaft run faster or slower, and thus sow more or less. The smallest gear-wheel of the cone has one-half as many cogs as the largest one, and the sliding-wheel in this gear will turn the feeder twice as fast as in the other, which illustrates the change.

Cone-gearing of "Farmers' Friend."

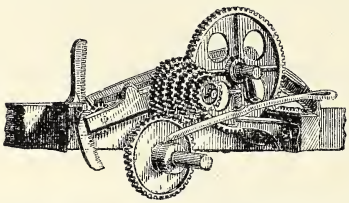


FIG. 116.—*American change-wheel arrangement.*

Telescopic conductors.

The tubes of the Gautreau and the Smyth drills are telescopic, and an advance upon the rattling string of consecutive cups shown in Fig. 112.

Gautreau.

The india-rubber conductor, so universal in America, is stated to have been first used by Hornsby, of Grantham, England. The writer has had no opportunity of verifying the statement, but it is probably true.

Smyth & Sons.

Smyth's patented telescopic tube consists of three parts, slipping easily one within the other. The material is sheet-iron, and the conductor proper may be said to consist of two tubes, b^1 b^2, discharging into a spheroidal cup, *c*, which rests on the bar *d*, and discharges behind the share which opens the furrow. The tube b^3, suspended by chains *g g*, is merely an envelope to prevent the entry of rain, clods, or wind into the tube, to clog it or disturb the fall of the grain from the spout *a*.

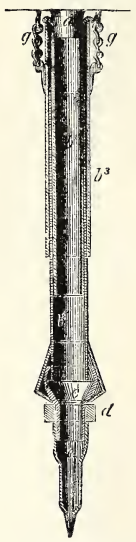


FIG. 117.—*Telescopic seed-tube. James Smyth & Sons, Peasenhall, England.*

Grain drills.

The telescopic tube is claimed as an improvement upon either the chain of cups or the caoutchouc tube.

Sizes and prices of Smyth drills.

The prices of the Smyth machines, Fig. 113 (with shafts), are as follows:

Number of machine.	No. of shares.	Width.	Price
		Meters.	*Francs.*
No. 2	9	1.50	760
No. 3	10	1.50	790
No. 4	11	1.80	840
No. 5	12	1.80	870
No. 6	13	2.10	920
No. 7	14	2.10	950
No. 8	15	2.40	1,000
No. 9	16	2.40	1,030
No. 10	17	2.70	1,080
No. 11	18	2.70	1,110
No. 12	19	3.00	1,160
No. 13	20	3.00	1,190
No. 16	7	.....	590
No. 16 (*a*)	8	.....	625

Extras.

The extras are:

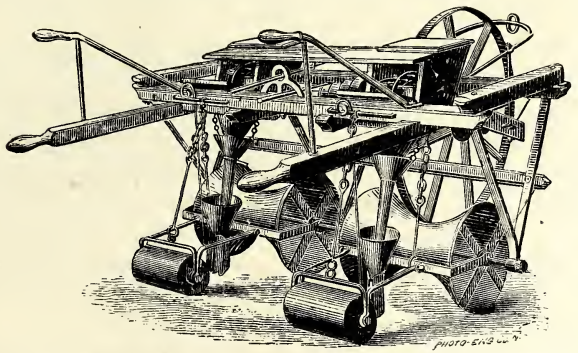
	Francs.
Fore carriage	150.00
Pallets for broadcast sowing, each	1.50
Levers with rollers to follow each share in sowing beet seed, each	25.00
Grass-seed boxes for broadcasting, one for each shear, each	11.00

These prices are a medium between those of MM. Delahaie-Tailleur & Bajac, of Liancourt (*Oise*), for the grain drill "*La Française*," and the machine of M. Faitot, of Maison-Alfort (*Seine*). For instance, taking one size drill:

Comparison of prices.

	Shares.	Telescopic tubes.	Caoutchouc tubes.
		Francs.	*Francs.*
Delahaye-Tailleur	12	1,020	.....
Smyth	12	870	.....
Faitot	12	725	630

Turnip and beet drill.



Corbett & Peele.

FIG. 118—*Turnip and beet seed drill. Corbett & Peele, Shrewsbury, England.*

Fig. 118 shows a special machine made by Corbett & Peele, of Shrewsbury, England, for drilling turnip and beet seeds on the summits of ridges.

Grain-drills. Corbett & Peele's turnip and beet drill (Figure 118).

The machine drills two parallel rows. On each side of the machine is a concave ridging-roller, a hollow share which receives seed from box above, and an iron roller for covering the seed. The seed-wheels are of the usual English form, having little hemispherical cups which dip up seed and drop it into hoppers, from which conductors lead to the hollow shares which open the furrows.

Price.

Price, 140 fr.

Drill-barrow. Guilleux.

The seed drill of M. Guilleux, of Segré (*Maine-et-Loire*), France, is a sort of drill-barrow, the front part carried by a fore carriage, and the rear governed by pressure upon or lifting the handles. The shares are so shaped as to take

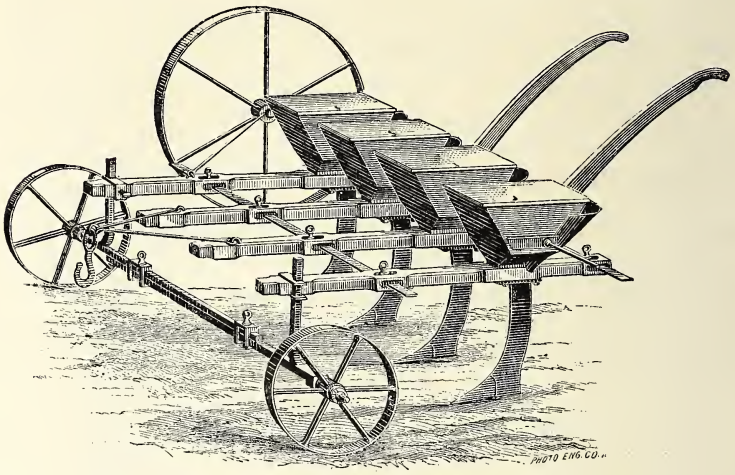


FIG. 119.—*Grain and seed drill. C. Guilleux, Segré, France.*

Description and mode of working.

hold upon the soil, and their depth is regulated by the adjustment of the front ends of the beams upon the standard rising from the fore axle. The mechanism is composed of a ground-wheel carried on the end of an axis traversing the boxes, which are supplied with seed, and in each box is a brush fixed to the axis, and revolving by the contact of the drive-wheel with the ground. The brushes drive the seed through holes in the rear of each box, and it falls through the hollow standard into the furrow opened by the share. A plate with holes of various sizes is placed in the rear of each box to regulate the exit of seed, and determine the quantity sown with a given rate of progression of the drill. On turning about, at the end of a field, the rear or drive-wheel connected by a knuckle with the axis, is lifted clear of the ground, which arrests the seeding action. On letting the

wheel fall to the earth and starting the horse, the machine resumes its action.

Grain-drills. Gilleux's drill-barrow. Price.

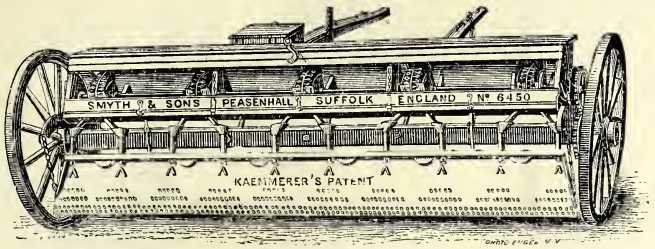
Price, with 3 shares, 120 fr.; 4 shares, 145 fr.; 5 shares, 165 fr.

Broadcast-sowers.

Broadcast-sowers.

Machines and appliances for sowing broadcast were shown from England, the United States, France, and Denmark.

The English form of the machine is shown in Fig. 120, in which the grain is lifted from the box by the cups on the revolving wheels, just as in the drills already described. These cups discharge right and left into small hoppers



English broadcast sower, Smyth & Sons.

FIG. 120.—*Broadcast-seeder. James Smyth & Sons, Peasenhall, England.*

with conductors, which lead the grain on to an inclined board, where it meets, in its gradual fall, with spreading pieces and pegs, which cause it to leave at last in a fairly distributed and even stream along the whole width of the machine.

The machine is drawn by one horse. The price of a machine 2.50 meters wide is 480 fr.; 3 meters wide, 510 fr.; seat, 25 fr. extra.

Price.

The Danish machine (Fig. 121) has the same features of the slanting board and scattering studs, but the latter are

Danish broadcast sower.

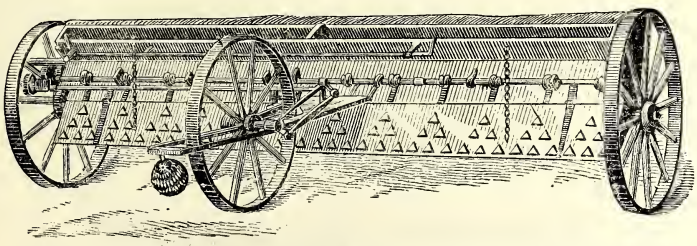


FIG. 121.—*Seed-sower. Rasmussen & Co., Stubbekjobing, Denmark.*

large and not so numerous as in the English machine of Smyth.

In the Danish machine made by Rasmussen & Co., Stubbekjobing, Denmark, the end wheels are only concerned in

Broadcast-sowers. Danish broadcast sower.

supporting the machine, the motion of the seed-distributors being obtained from the rear wheel.

The quantity of seed sown per acre is determined by means of change-wheels, 12 in number, and capable of being fitted upon either of the two shafts—the full-length one, on which the distribution-rollers are fixed, and the shorter one, which forms the connection between the hind wheel and the sowing-axle. The 12 change-wheels present 105 different speeds of the sowing-axle. The change-wheels have, respectively, 10, 11, 12, 13, 14, 15, 18, 21, 24, 27, 28, 30 cogs.

Rasmussen & Co.

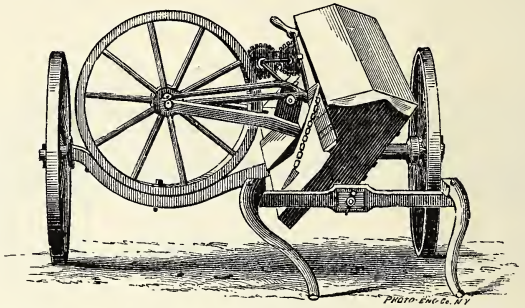


FIG. 122.—*Seeder on cross-axle. Rasmussen & Co., Stubbekjobing, Denmark.*

The hind wheel is lifted from the ground in turning.

To facilitate the transportation of the machine in narrow lanes and through gateways, a cross-axle is furnished, to which the end wheels are temporarily fitted.

The prices are as follows:

Sizes and prices.

Width of machine.	For horses.	Price.
		Francs.
16	2	427
12	1 or 2	360 to 370
10	1	353

Cross-axle and covered sowing-board (extra), 60 francs.

English seeding barrow.

In the broadcast seeding barrow made and exhibited by Hunt & Tawell, Earl's-Colne, Essex, England, the long seed-hopper is supported on a light barrow.

Hunt & Tawell.

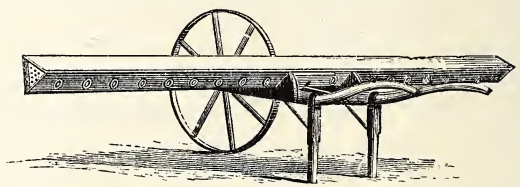


FIG. 123.—*Broadcast seeding barrow. Hunt & Tawell, Halstead, England.*

It serves to sow every species of grain from turnip to clover. The quantity sown is regulated by the copper slides,

across which the seed is projected by the turning brushes in the hoppers, which are driven by connection with the ground-wheel. *Broadcast-sowers.*

Sweden exhibited a broadcast-seeder on a barrow and one on wheels.

For converting a grain-drill into a broadcast-sower substantially the same device is used in Europe as in America. In the latter the conductor is detached and a sheet-metal flaring-spout is placed beneath the discharge of the feed-cup and scatters the grain upon the ground. The French device is similar; the one shown is specially designed for sowing flaxseed broadcast, but is adapted for other species of grain. It is, however, placed lower down than is usual with us, being attached to the share and held by a set-screw. Converting grain-drill into broadcast machine.

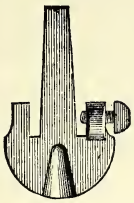


FIG. 124.—*French broadcasting-plate.* French portable broadcast-sower.

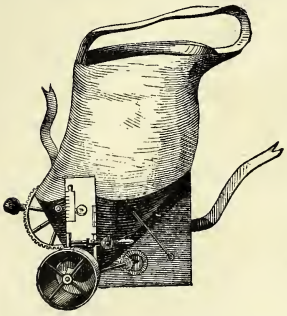


FIG. 125.—*Broadcast-seeder. J. Pernollet, Paris.*

The centrifugal broadcast-seeder was shown in several forms, as a hand apparatus and rigged in a wagon which was driven over the field. It is declared capable of sowing 5 to 6 acres

FIG. 126.—*Pernollet's seeder in use.* Pernollet.

of wheat per diem, say 8 to 12 bushels. The width of land sown is from 7 to 8 meters. Capacity.

Broadcast-sowers.

The operator should walk either against or with the wind, but never across it. A regulator with numbers is placed at the exit to determine the quantity of grain.

Price, 40 fr.; weight, 3 kilos.

Fertilizer-sower.

Fertilizer-sowers.

Machines for sowing fertilizers in drill or broadcast, independent or attached to grain-drills, were shown from England, the United States, and France.

American combined machines.

In the United States grain-drills exhibited the fertilizer-sower was an adjunct to the seeding portion, the hopper being divided into two parts, the forward portion for the grain and the rearward for the fertilizer. A cup beneath receives both and carries them unitedly to the tube, which conducts them to the furrow made by the share or hoe, as it is variously called.

"Farmers' Friend" fertilizer-sower.

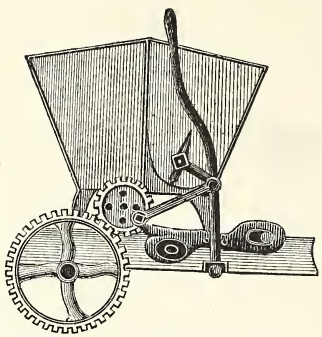


FIG. 127.—*Combined drill and fertilizer. Farmers' Friend Manufacturing Company, Dayton, Ohio.*

The cut shows the hopper in section, with the exterior actuating apparatus in elevation. The division to the right contains the fertilizer and has a curved bottom of galvanized iron. Concentric with the curved bottom is a shaft, which is oscillated by a connecting-rod from a pinion driven by a cog-wheel. To this shaft iron radial arms are attached, the upper portions of which stir the fertilizer and keep it from bridging, while on the lower end of the arms is a light iron bar, which is as long as the hopper, and moves back and forth over the exit-holes to prevent their becoming clogged.

Description and mode of operating.

The lever at the end of the hopper is for throwing the fertilizer in or out of gear independently of the grain-drill. A lever moving over a graduated plate regulates the amonut sown, from 50 to 800 lbs. per acre. The fertilizer is geared from one end of the machine and the seed-drill from the other, so as to equalize the draft, the two ground-wheels of the machine running the respective portions.

The use of artificial fertilizers, though increasing in the United States, is by no means so common with us as in some European countries.

Farm of M. Millot, Lorraine.

On the farm of M. Millot, at Merchines, near Vaubecourt, in the Department of the Meuse, known to the writer, and consisting of 750 acres, 500 acres are under the plow an-

nually in lucern, beets, oats, tobacco, maize, potatoes, and wheat. The yearly purchase o 'nitrate of soda and sulphate ammonia is from $3,000 to $3,600. The quantity sown with each crop is as follows:

Fertilizer-sowers.

Farm of M. Millot, Lorraine.

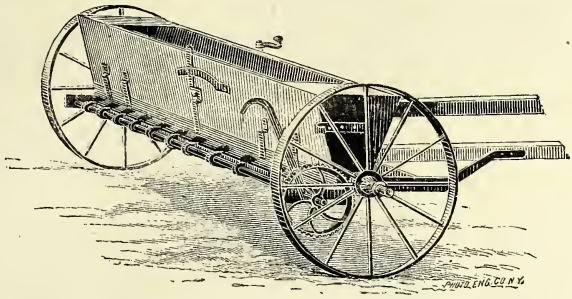
Nitrate of soda, 160 lbs. per acre for wheat or oats.

Nitrate of soda, 440 lbs. per acre for beets.

Nitrate of soda, 880 lbs. per acre for tobacco.

Use of chemical fertilizers.

As sulphate of ammonia has 20.5 per cent. of azote, and nitrate of soda but 15.5 per cent., when the former is used the quantity is proportionally less. The quantities men-



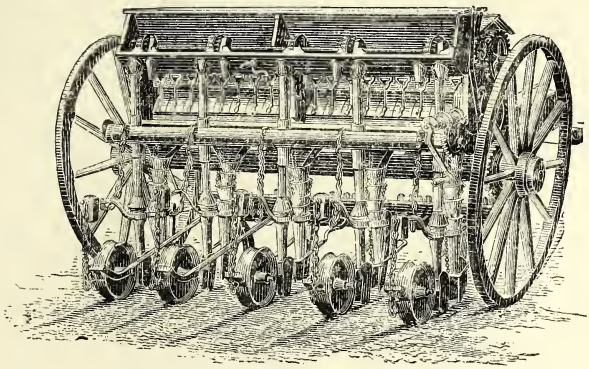
French fertilizer-sower.

Josse.

FIG. 128.—*Fertilizer-sower. L. P. Josse, Ormesson, France.*

tioned are sown with each recurring crop, besides the spreading on 25 acres per annum of 40 metric cubes per acre of marl dug on the farm. The quantity of stable manure also is very large from horses and fatting sheep and from a dairy of 150 cows.

Use of fertilizers with each recurrent crop.



English fertiliser-sower and beet-drill. Smyth & Sons.

FIG. 129.—*Combined beet-seed and fertilizer drill. James Smyth & Sons, Peasenhall, England.*

The form of fertilizer-sower (Fig. 128) made and exhibited by M. Josse, of Ormesson (*Seine-et-Oise*), is particularly adapted to damp or deliquescent fertilizers, which are drawn by endless revolving chains passing through the hopper and dragging out the pulverulent material, which is

Fertilizer-sower of Josse. (Figure 128.)

Fertilizer-sowers. disengaged and dropped upon the ground. The hopper holds 75 gallons; the price is 300 fr.; the width of land sown is 2 meters, and, as the top of the hopper is but one meter from the ground, loading is easy.

Smyth & Sons. (Figure 129.) James Smyth & Sons, of Peasenhall, Suffolk, England, have what may be considered the favorite drill, both in England and France.

On account of their wide-spread celebrity, the machines of this firm have been already shown in the two forms, drill and broadcast. Fig. 129 shows a special machine for sowing beet seed with artificial manure.

Beet-drill and fertilizer-sower.

The machine shown has a range of 5 hoes, with a distance apart of 0.45 meter, but the machines vary in the number and interval distance of the hoes and in price.

Sizes and prices.

No. of hoes.	Distance.	Price.
	Meters.	*Francs.*
4	0.45	1,200
4	0.50	1,235
5	0.45	1,310
5	0.50	1,345
6	0.45	1,420
6	0.50	1,455

Mode of operation.

The seeding is performed by its own set of conductors and hoes, in such manner that the fertilizer is covered with earth in advance of the deposit of the seed, which is not placed in contact with the fertilizer, so that the special nourishment to the roots of the young plant is not furnished until they have attained a certain development. The concave-faced rollers, which are independent of the hoes, follow in the rear and make a little ridge over the seed and fertilizer, which compacts the soil and makes the row of plants more conspicuous in the earlier stages of their growth.

Beet-drilling attachment to ordinary grain-drills.

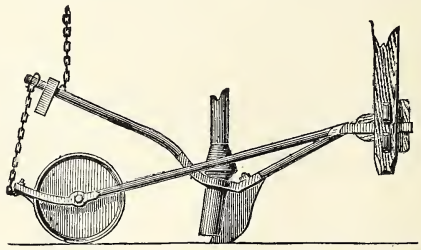


FIG. 130.—*Beet-seed planter. James Smyth & Sons, Peasenhall, England.*

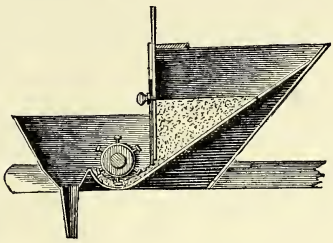
Smyth & Sons. The device shown in Fig. 130 is for attachment to the ordinary drills of this firm (Fig. 113), to adapt them to drilling beet seed. The roller has flat, concave, or convex face, as may be ordered.

Price. Price for each set, 25 fr.

Single-row planters and seeders.

Single-row planters and seeders.

The single-row implement, known as a seeding barrow (*semoir à brouette*), is made to work either with cups (*semoir à godets*) or with a brush (*semoir à brosse*).

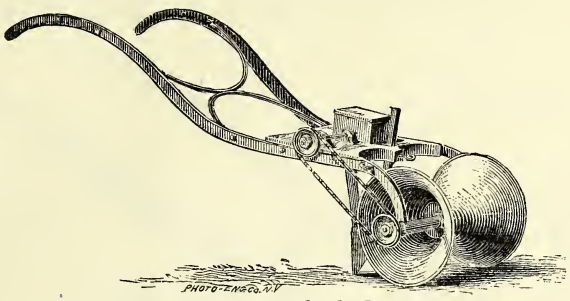


Seeding barrow.

Cup-feed.

FIG. 131.—*Cup-feed.*

Some of these machines are primarily intended to follow after a plow or in a furrow laid out by a marker or other tool, while others have a hoe which opens a furrow for the seed, and some have a little rake or a roller trailing in the rear to cover the seed.



Seeding barrow.

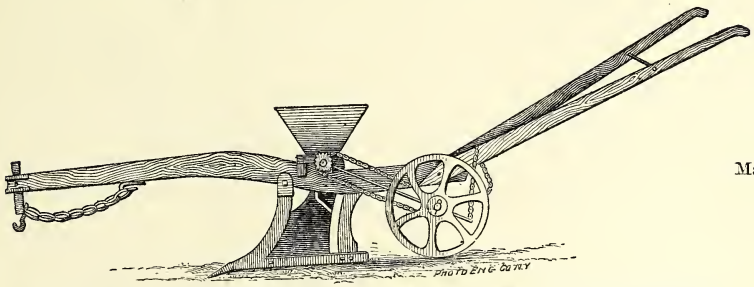
Brush-feed.

FIG. 132.—*Brush-wheel feed.*

The plow-drill of M. Magnan, Aix-en-Provence (Fig. 133), is a revival of the old drill of Hindostan which was probably in use in the watered rice fields of the East, noticed by Aristobulus, one of Alexander's generals. The drill-plow is

Plow-drill.

Ancient use.



Magnan.

FIG. 133.—*Provençal plow-drill. L. Magnan, Aix-en-Provence, France.*

still used in Southern Asia and was exhibited at the Centennial Exhibition and in Paris from India, Java, and China. It is not, however, so shapely an implement as the Provençal plow (Fig. 133).

Cost of the seeding attachment 25 fr.

Price.

Cups, slides, or brushes are used in feeding the grain through the orifices in the bottom of the hopper or into

Planters and seeders.

tubes, and the seed is then led by a conductor or simply dropped in rear of the share which has opened the furrow to receive it. The next furrow covers it, or a trailing coverer, as has just been stated.

Italy exhibited small seed-drills—a box on a wheelbarrow, with a pair of shares to cover the seed, for row planting; also a 4-furrow drill with wheels, for horse work.

Implement for marking rows.

In connection with this class of machines may be mentioned an implement very common in a crude form among us for marking out corn ground for check-row planting. With us a sort of sled with three runners is used, making small furrows 3′ 6″ or 3′ 8″ apart, as may be customary or suited to the size of the corn. The two-horse check-row planter crosses these marks, making furrows at right angles, and just at the intersection the corn is dropped. The French

Bodin's

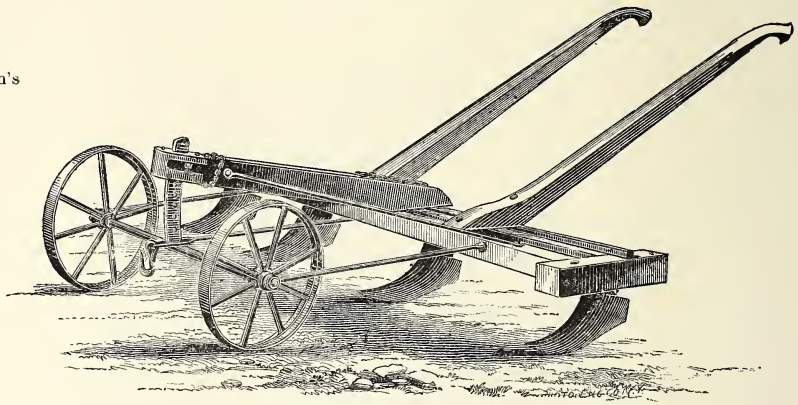


Fig. 134.—*Rayonneur or marker. E. Bodin, Rennes, France.*

implement, made by E. Bodin, of Trois-Croix, Rennes (Fig. 134), is specially intended to make furrows in which colza or other plants are set out; and also for laying out ground for certain kinds of seeding machines. The cast-iron shoes are secured by set-screws to the transverse bar, on which they are adjustable as to relative distance by means of a series of holes in the bar. The weight is 80 kilos, and the price 110 fr.

row-marker.

Hand-planter.

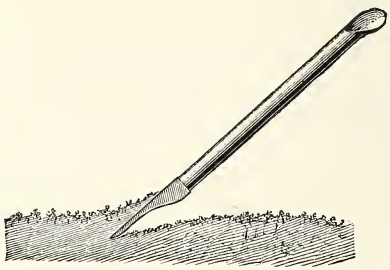


Fig. 135.—*Seed-planter.*

Hand-planters and hand-drills were shown in great variety, but of three general types.

The simple planter (Fig. 135) is a sheet-iron tube, with an enlarged bell-shaped mouth at the upper end and a sharp

iron spud with a steel point, which is thrust into the ground. The seed is dropped into the tube by the left hand. It is designed for the seeds of trees, such as acorns, pine and birch seeds, etc., being especially adapted for starting plantations of trees; also for beet seed, which is clinging and does not run freely in a piston-feeder. *Planters and seeders.* Hand-planter.

Price, 6 fr. Price.

The planter for small grains (Fig. 136) and for those which run freely, such as some kinds of tree seeds, beans, pease, and those garden seeds which are planted in detached hills, consists, like the other, of a tube and lance-shaped spud. It, however, carries the seed in the tube, the upper end having a cover, and the seed is discharged at a point near the lower end; pressure upon the piston, which projects above, opens a valve and permits a certain quantity to escape. It is used with both hands, and the stroke of the plunger-rod is adjustable to regulate the extent of valve opening and limit the amount of seed discharged at each impulse. Hand-planter.

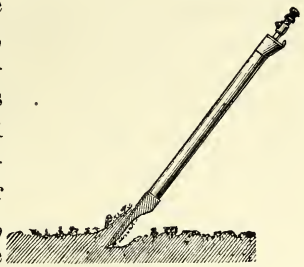


FIG. 136.—*Seed-planter.*

Price, 14 fr. Price.

The garden seeding machine (Fig. 137) is designed for all kinds of seed to be sown in drills, pease and maize, as well as the smaller and lighter seeds, such as beet, carrot, and parsnip, the opening being regulatable. It is pushed by the operator, the roller-wheel being in advance, followed by the share, behind which the seed drops from the box, and a hoe in the rear fills the little furrow and covers the seed. The seed-slide in the bottom of the hopper is worked by the vertical motion of the handle, which is rapid or slow, according to the rate at which the operator walks, or the desired distance apart of the bunches of seed. Garden seeding machine.

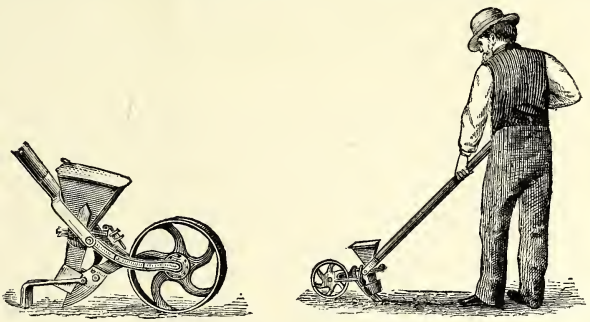


FIG. 137.—*Hand seed-drill.*

Hand seed-drill.

Price, 20 fr. Price.

Field of Marmont.

FIELD OF MARMONT.

(See map facing.)

Harvesting machine trials.

HARVESTING MACHINES.

Introductory.

The French newspapers do not allow it to be forgotten that the reaping machine was first made and used in Gaul.

The reaper in ancient Gaul.

"It was the Gauls, *our fathers*, who, says Palladius, made the first reaper. The description given by him indicates a sort of cart furnished with two wheels; an ox in the reverse direction in the shafts pushed the machine like a wheelbarrow against the wheat.

Editorial in "*La France*," May 28, 1878.

"The edge of the cart was armed with a comb having long teeth, where the ears caught and were cut off by the edges of the knives and tumbled into the body of the cart. The straw remained after the ears were removed, and was either left in the field or gathered later.

Case reaper.

"The reaper set up in the American section of the Exposition was made by Messrs. Case, of Wisconsin, and is the Gallic reaper, perfected it is true, but based on the same agricultural system pursued for ages in some portions of China, where they reap by two operations, first with a sickle to gather the wheat and then with a scythe to save the straw.

"The machine of Messrs. Case, of Wisconsin, disturbs all our ideas of progress in harvesting by machinery.

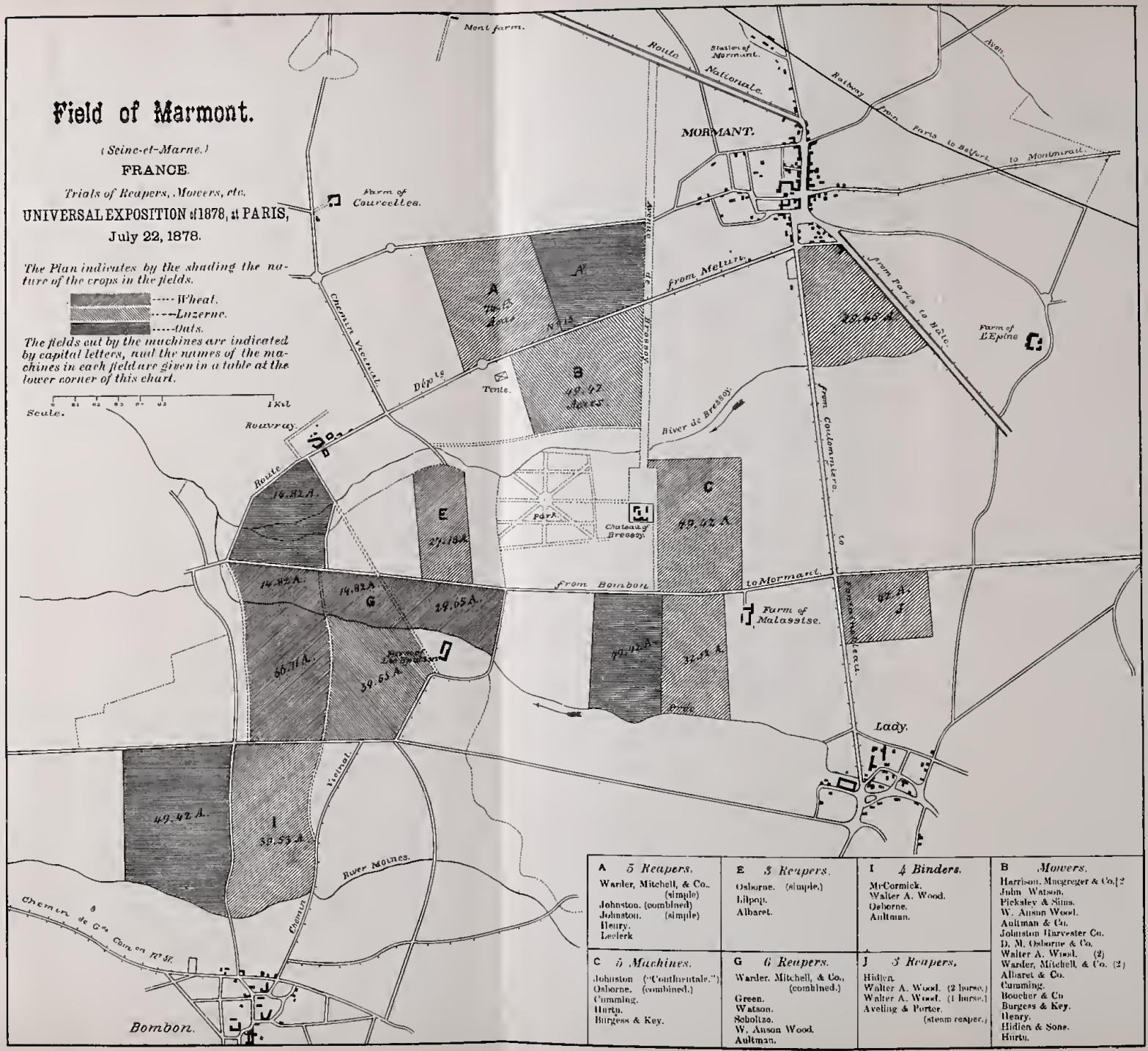
Excellence of the American and English agricultural machinery.

"We have carefully examined it in the shed where they have carefully hidden, along the Avenue Suffren, the magnificent American and English agricultural machines as if they did not merit a place of prominence in the Exposition. * * * We cannot, however, neglect rendering our homage to the truth in declaring that it is to this side of the Exposition grounds that agriculturists and manufacturers should turn their attention."—*La France*, May 28, 1878.

The region referred to by Pliny and Palladius.

The term "Gaul" was, in the days of Pliny, who first described the Gallic reaper, rather an indefinite geographical expression, and the district in which Pliny describes the machine as working, 1,800 years ago, was Rhætia, and the "plains" upon which it was used were probably those of the Adige, a part of that marvelously fertile tract between the Italian Alps and the head of the Adriatic—a land whose celebrity in the earliest historic times for wool, wine, and

Rhætia.


Field of Marmont.
(Seine-et-Marne.)
FRANCE.
Trials of Reapers, Mowers, etc.
UNIVERSAL EXPOSITION of 1878, at PARIS,
July 22, 1878.
The Plan indicates by the shading the nature of the crops in the fields.
Wheat.
Luzerne.
Oats.
The fields cut by the machines are indicated by capital letters, and the names of the machines in each field are given in a table at the lower corner of this chart.
Scale.
1 Kil
Mont farm.
Route Nationale.
Station of Mormant.
Railway from Paris to Belfort.
to Montmirail.
MORMANT.
Farm of Courcelles.
Chemin Vicinal.
Route Départementale.
from Melun.
from Paris to Bâle.
Farm of L'Epine
Dépôt
Tente.
River de Bressoy.
from Coulommiers.
Rouvray.
Route
Park
Château de Bressoy.
from Bombon.
to Mormant.
Farm of Malassise.
Lady.
Chemin de Gde Com on Nre St.
Chemin
Vicinal.
River Moines.
Bombon.
A 5 Reapers.
Warder, Mitchell, & Co., (simple)
Johnston. (combined)
Johnston. (simple)
Henry.
Leclerk
E 3 Reapers.
Osborne. (simple.)
Lilpop.
Albaret.
I 4 Binders.
McCormick.
Walter A. Wood.
Osborne.
Aultman.
B Mowers.
Harrison, Macgregor & Co.[2
John Watson.
Picksley & Sims.
W. Anson Wood.
Aultman & Co.
Johnston Harvester Co.
D. M. Osborne & Co.
Walter A. Wood. (2)
Warder, Mitchell, & Co. (2)
Albaret & Co.
Cumming.
Boucher & Co
Burgess & Key.
Henry.
Hidien & Sons.
Hurtu.
C 5 Machines.
Johnston ("Continentale.")
Osborne. (combined.)
Cumming.
Hurtu.
Burgess & Key.
G 6 Reapers.
Warder, Mitchell, & Co., (combined.)
Green.
Watson.
Sebolize.
W. Anson Wood.
Aultman.
J 3 Reapers.
Hidien.
Walter A. Wood. (2 horse.)
Walter A. Wood. (1 horse.)
Aveling & Porter. (steam reaper.)

race-horses indicates the variety of its climates and the advanced character of its productions, and whose valor in attack recalled the Brennus of the Senonian Gauls from the pillage of Rome to the defense of their pleasant homes on the Mincio and Lago Garda. *Harvesting-machine trials.*

The Case reaper was not shown at the trials, but was a very different thing from the crude reaper of the Venetii, which resembled our clover-headers. It had, however, the two points upon which the journalist insists—it was pushed by the team and the comb in advance stripped the heads of the standing crop and saved them. The Gallic reaper of A. D. 79.

In the report of the trials of harvesting machinery at Marmont, July 22, 1878, descriptions of the principal machines will be given, and included therewith will be some of merit which were in the Exposition but not brought into the field of competitive trial. The object is to avoid considering such in a separate paper, which would require some duplication of statement. Report includes some machines not worked at the trials.

Nine fields of wheat, oats, and lucern in the vicinity of Marmont, Bombon, and Lady, in the department of the *Seine-et-Marne*, were set apart for the trial, though but seven of them were used, the oat fields not being cut. The site of the trials.

The machines competing at the trial were as follows: Classes of competing machines.

4 binding-reapers.
21 simple and combined reapers.
1 steam-reaper.
16 mowers.
7 horse hay-rakes and stubble-rakes.

The accompanying plan, facing page 120, is a map of the field, and embraces an area of 5 kilometers east and west by $4\frac{1}{2}$ kilometers north and south, equal to $22\frac{1}{2}$ square kilometers, or little over 5,500 acres, of which about 750 acres were devoted to the machines. The fields were, however, so scattering that the area traveled over may be said to have occupied in the aggregate 3,000 acres. Description of the field of Marmont.

Plots in the various fields were marked off by cradling around, so that each machine had a fair place to commence. Lots were drawn for places, and the machines started, as nearly as could be arranged, at the same time. A section of the committee was appointed to each of the six fields, which had from 3 to 6 machines apiece. Alignment of machines.

Harvesting-machine trials.

The binding-reapers were allotted to a field by themselves and commenced later in the day, drawing lots for position.

As the day was hot and the machines numerous, the jury had a hard day's work. In a number of instances the examination had to be made the next morning of the gavels lying in swath, as none were bound after the machines. It seems to be the usual French practice to allow the gavel to lie a few days before binding, the reason probably being to afford it time to dry out more thoroughly. The delay appears to the writer to be of doubtful value, as the gavel receives more moisture from the ground than would be imprisoned by prompt binding. The climatic conditions, however, of France and the United States are so different that it is rash to find fault with a national practice.

The field of Marmont.

Four binding-reapers were entered for competition, all of them from the United States. *Binding-reapers trials.*

Number on the list.	Name.	Residence.	Price of machine.	Location in the field.
			Francs.	Entries.
34	C. H. McCormick	Chicago, Ill	2,000	I, 2
36	Walter A. Wood	Hoosick Falls, N. Y	2,000	I, 4
35	D. M. Osborne & Co	Auburn, N. Y	1,750	I, 1
32	Aultman & Co	Canton, Ohio	1,850	I, 3

It may be mentioned that other binders were shown at the Exposition on the Champ de Mars, but were not brought into the field: Johnston's string-binder (American), William Anson Wood's wire-binder (American), Howard's wire-binder (English), Neale's string-binder (English). Landelle's sheaf-binder, to follow a reaper and bind with wire, was extensively advertised, but the author of this report never could find it and supposes it was withheld from view. *Machines not tested on the field.*

Four were in the field and five others in the buildings (if Landelle's were indeed there). In the September following, at the Royal Agricultural Society's trials at Bristol, England, 10 binders went into the field, but the three which succeeded best were those which received awards at the Marmont trials, and the gold medal of the society was given to the McCormick binder, which received the grand prize at the Exposition at Paris. Of the 11 binders at Bristol, nine used wire and two used string. *Whole number of machines at the Exposition.* *Wire and string.*

The binding-reapers were started in the afternoon of the 22d in a field specially selected for them. As it was to be a question of the capability of the binders, it was thought best not to complicate the problem by setting them to work in down or tangled grain, in the worst of which it was not possible for them to compete with the sweep-rake machines.

The order of the quality of the performance was this: *Order of the quality of performance.*

C. H. McCormick.

Walter A. Wood.

D. M. Osborne.

The Aultman machine broke some portion early in the trial and was distanced.

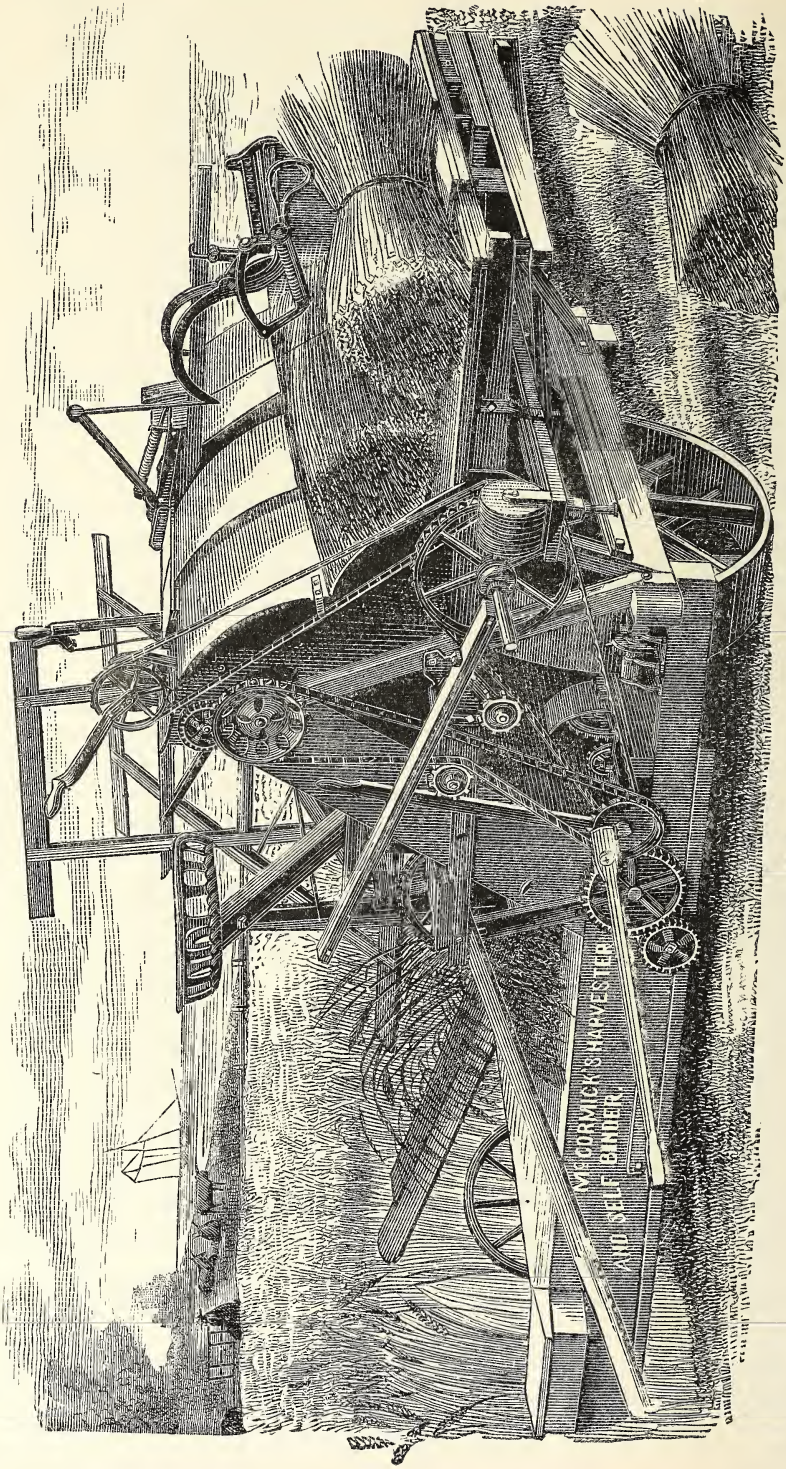


FIG. 138.—*McCormick's binding-reaper (rear view).*

Binding-reaper trials.

The machines agreed in each binding with No. 20 wire and in putting a single band around the sheaf. The McCormick is under the Witherby patents and uses two wires on their respective spools, and consequently has two knots a little distance apart. The other machines use but one wire, and consequently make but one knot. In all cases the "knot," so to call it, is made by bringing the two parts of the wire into parallelism and twisting them around each other, the wires being cut to release the sheaf.

Comparison of the methods of the wire binders.

Disposal of the bound sheaf.

In the case of the McCormick and Osborne machines the sheaf is pushed off the table by the movement of the succeeding one, but in Walter A. Wood's machine it is thrown from the table by the positive motion of one of the compressing arms as soon as the tie is completed.

Kind and cost of wire.

The wire is of American gage No. 20, and, the writer was informed, has about 360′ to the pound, at a price of, say, 10 cents. The average cost of wire to an acre may be 50 cents, and the saving in grain over hand-binding will frequently pay for the wire. This will depend somewhat upon the condition of the wheat.

Objections to wire binding.

The use of wire for binding has occasioned not a little strife between the makers of the binding-reapers and the ordinary harvesters, respectively. The strife is not mitigated by the appearance upon the scene of the string-binding reaper, which substitutes hempen cord for wire.

Advantages of wire over straw bands.

The wire-binders claim that, as compared with hand-binding with straws from the gavel, the bands are tighter, not so easily unloosed, and that the sheaves shock and stack better. Also that the sheaves stand wet weather better, being not so apt to mold under the bands, as the wires do not retain moisture.

Objections to wire in the straw,

It is also claimed, and the experience of the writer is to the same result, that the wires create no difficulty in thrashing, nor does the loss of wire in the straw render it dangerous to cattle which feed upon it. Shears are, moreover, provided which cut the wire and then hold one end of it so that it can be thrown aside and not pass through the machine.

and to occurrence of scraps of wire in the wheat.

The occurrence of scraps of wire in the wheat has annoyed the millers, to some extent, and they now use magnets to arrest iron scraps as the wheat passes to the mill-hopper. A somewhat unexpected result has been finding miscellaneous iron scraps, such as pieces of nails, etc., equal in quantity to the fragments of binding-wire.

The saving of labor in reaping.

The self-binders have outlived the objection which has been made to them, as the balance of advantages has been in their favor, the saving of five men binding after a ma-

Binding-reaper trials.

chine being as great an improvement over the ordinary reaper as that was over the cradle. In fact it is much

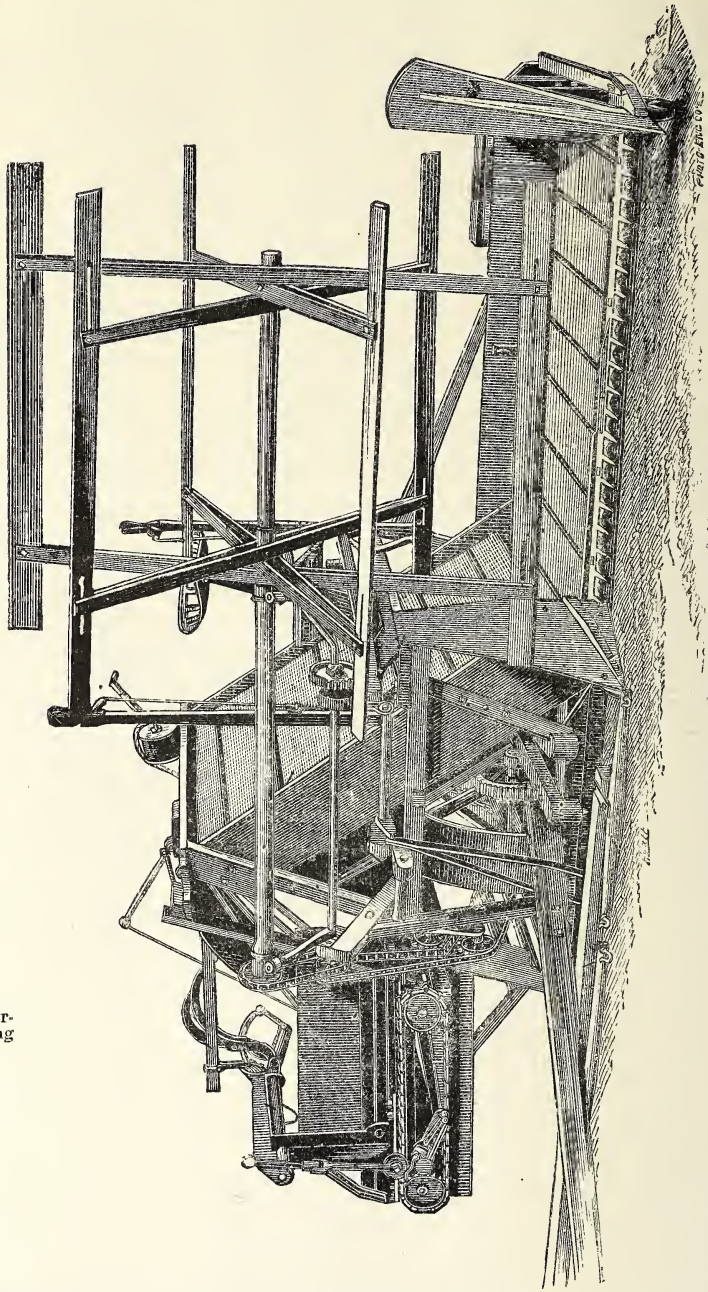


FIG. 139.—*McCormick binding-reaper (front view).*

C. H. McCormick's binding reaper.

The saving of labor in reaping.

greater. It would be necessary to take into consideration the weight and condition of the wheat in the field in making a definite statement, but it is not beyond the truth to state

Binding-reaper trials.

that whereas one sweep-rake reaper will cut as much as three cradlers, one binding-reaper will cut and bind as much as 6 men working with an ordinary reaper.

Comparison of machine and hand binding.

In standing wheat the work will be done better by the machine than bound by hand. In down or laid wheat the world has yet to see anything better than the sweep-rake machines of the Johnston and Whiteley patterns.

Comparison of the machines.

The four machines—McCormick, Wood, Osborne, and Aultman—agree in adopting an endless traveling-apron with slats, which receives the grain as it is cut by the knife and laid over by the reel upon the platform of the machine.

Platform apron.

Elevating arrangement.

In the McCormick and Osborne machines the grain is then elevated between two inclined slatted aprons traveling in parallelism a few inches asunder, and is discharged down an inclined board which conducts it to the binding-table. In the Wood machine it is elevated by spurs on a number of parallel traveling-bands, a series of guiding-rods above fulfilling the duty of the second apron in the other machines.

Similarity of structure up to a certain point.

To some extent a general description will apply to each of the machines exhibited, and this similarity is striking to a merely casual observer up to a certain point. Without entering into elaborate detail, it may be said in a general way that the grain collects in the bight of the wire, the end of which is held by the binding-arm, the *standing part* (as a sailor would say) being upon the reel beneath or behind the table.

The binding,

When sufficient grain has collected for a sheaf, the binding-arm carries the end of the wire over and then behind the sheaf, brings the end of the wire against the standing part, and the two being thus parallel and in contact beneath the table, are grasped, cut, and twisted together, four to six turns, quite sufficient to prevent their becoming detached either by accident or the distension of the sheaf.

and twisting the wire band.

Retaining the new end in the binding arm.

The new wire end, beyond the severance just made, is automatically grasped by the finger on the end of the binding-arm, which then rises and retires, pulling off from the reel sufficient for another band, and in the bight of the new length of wire the grain commences at once to collect for another sheaf.

This description will answer approximately for each of the machines, but in the means adopted, the details of the work, the differences are both numerous and important.

Same general method of cutting.

All the American binders at the Exposition have the same general method of cutting the grain and carrying it to the binding apparatus. This is similar to the Marsh harvester,

Binding-reaper trials.

the platform being rigidly connected to the carriage, which has a single driving-wheel. The grain falls into an apron traversing transversely and this delivers it continuously to an inclined slatted or toothed apron, which elevates it and discharges it on to the binding-table, where it is encircled by the wire or twine of the binder-arm. At this point may be said to begin the line of demarkation between the machines exhibited, but which it would take considerable space to describe technically and in detail.

Points of general similarity in the machines,

That some machines are not so readily adapted to the attachment of a binder is clearly demonstrated by their owners forsaking in some respects the types of their peculiar machines, and assimilating a common pattern and a common method until the binding point is reached. Even here there is a certain similarity, as the action resembles that of the human arm grasping the end of the wire in its fingers, and carrying it round the gavel so as to meet what the sailors would term the "standing part" of the wire on the other side of the sheaf. Brought into juxtaposition, the parts of the wire are gripped and twisted together. A motion, usually of the sheaf, then brings the wire against a cutter, which severs it, and the sheaf is free, while the new end of the wire is retained by the fingers of the arm, which rises to repeat its action, and the sheaf tumbles off the table on to the ground. There are several methods of making the compression and of obtaining the necessary tension of the wire, but perhaps the Walter A. Wood machine most nearly represents the human mechanism, inasmuch as it has a left arm as well as a right, and both are chronically bent as if embracing had been their whole duty in life. The sheaf is tightly held by these while the tie is made, without severe tension on the wire.

up to the binding point.

Similarity of the general mode of forming the twisted tie.

Difference in details.

Diversity in the apparatus for tying.

The greatest diversity appears in the apparatus for tying. To cite them comparatively in a few words, it may be said that in the Wood machine the curved binding-arm is rotated in a vertical plane at right angles to the elevating-platform upon an axis which continues in one position. In the McCormick machine the binding-arm rises and falls while its axis alternately advances and recedes for rather more than the thickness of a sheaf; and in the Osborne machine the arm, supported from the back instead of over the side of the binding-table, has a continuous rotary sweep or crane motion. In the Wood machine the whirl or small pinion for twisting the wires together, and also the small clip or shears for severing the wire, are carried in the needle end of the binding-arm; but in the McCormick and the Os-

Comparison.

borne machines these are placed under the table and are actuated independently of the arm. The exceedingly ingenious though intricate appliances by which the wire is passed round the sheaf-bunch, held while being twisted, cut asunder, and the free end caught ready for passing round the next sheaf, the contrivances for maintaining the requisite degree of tension on the wire, and for compressing and delivering sheaves, cannot here be described at length. A peculiarity in Mr. McCormick's machine is its use of two spools of wire, the two wires being cut after the binding of each sheaf, and twisted together again in readiness for the next. The binding-arm of Mr. Wood's machine is actuated by a simple bevel-wheel movement, the to-and-fro traverse of the arm in Mr. McCormick's machine is obtained by a remarkable endless-chain motion, and the crane motion of the arm in the Osborne machine is given by a peculiar device resembling the conical axial motion of the disk steam-engine. In the McCormick binder the binding apparatus is carried upon a reciprocating frame having a traverse motion, inward and outward, imparted to it in binding a sheaf, the binding-wire being taken from two spools—each spool having its own peculiar function to perform. Thus, at the outward extremity of the guideway the compressing-arms are thrown open, one above and the other below, ready to meet and compress the gavel on the gaveling-concave the moment they are brought forward to it by the inward traverse. This done, the binder-arms, with the wires from the two spools, instantly close, thereby surrounding the sheaf, the two wires being twisted, cut off, and held fast for another sheaf during the outward traverse of the binder-frame. The advantages claimed by this are: 1st. That only half the wire is given off from each spool, as compared with machines only having one spool, so that there is less liability of breakage or harm to the wire. 2d. No wire is given off the lower spool unless a sheaf is bound, so that no harm or loss of time is sustained should a miss take place in turning by any oversight of the driver, starting of the team, or otherwise. 3d. A cleaner and better separation takes place of the corn surrounded by the compressor-arm, and that flowing down from the elevator—as the binder-arms leave the gaveling-concave in their outward movement, thus allowing the corn to collect on the concave for another sheaf without any interruption. 4th. Less power is required to work this reciprocating mechanism than is consumed when the sheaf has to be squeezed more roughly over an equal distance by the binder-arm against the concave. 5th. The sheaves are more gently

Binding-reaper trials.

Comparison of the structure of the machines.

C. H. McCormick's machine. (Figures 138, 139.)

Binding-reaper trials.

discharged from the machine, thus avoiding thrashing, when the grain is overripe. The traverse of the binder in the length of the sheaf for binding it in the proper place is very easily effected.

Walter A. Wood's binding-reaper.

Mr. Walter A. Wood has worked long and successfully to introduce the binder, and his name is ineffaceably written in the history of the reaper enterprise.

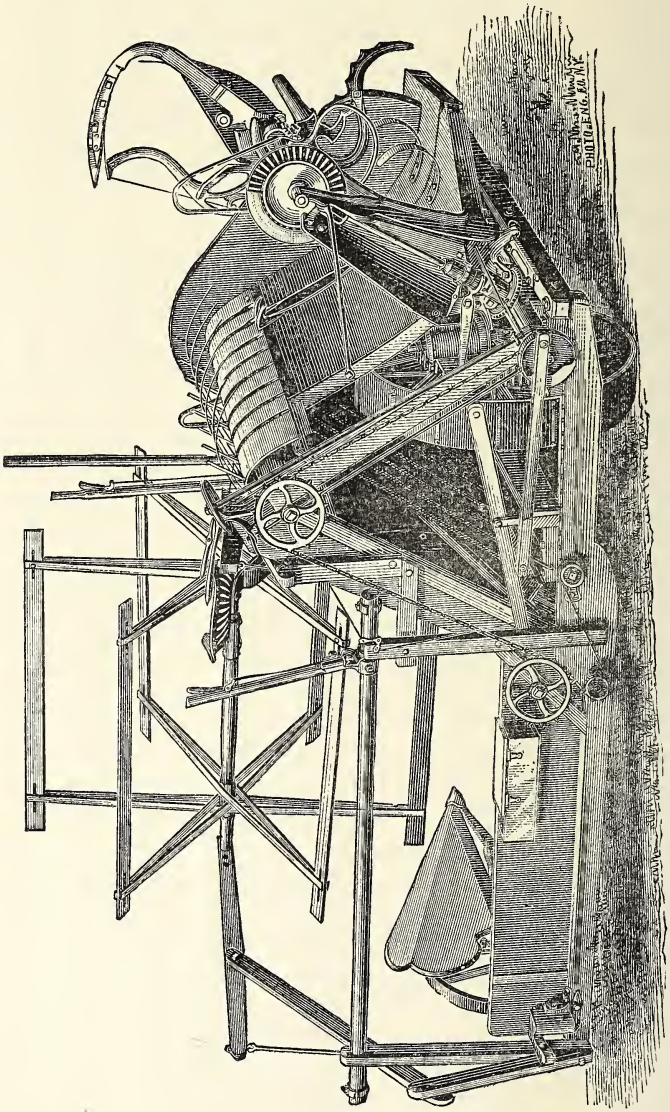


FIG. 140.—*Walter A. Wood's binding-reaper (rear view).*

In the Walter A. Wood machine the arms are almost human in their action, and have a curious resemblance to the action of a man binding in the field. He grasps the band

Binding-reaper trials.

in his right hand, and, stooping down, passes his bent right arm around the sheaf until the band can be grasped by the left hand, when the right hand is slipped back along the band. At this point, speaking of the human binder, the tension is given, the part of the band in the left hand being held fast against the sheaf while that in the right is drawn tight, slipping against the left hand. A round turn and a tuck under the standing part secure the band.

Walter A. Wood's machine. (Figure 140.)

None of the machines exhibit this action exactly, for this reason, among others, that the machines all deal with a continuous length either of wire or twine, while the human arms operate with a single length for a sheaf. The iron arm, carrying the end of the wire in a hand, passes it around the waist of the sheaf—Ceres, let us say—and hugs her so tightly that she swells at the extremities. The end of the wire having been brought against the standing part and the two twisted together, the wire is cut at a point beyond the twist, and the sheaf is free.

There are several points of difference in detail in the methods of passing the band and making the tie, but the most important point is perhaps in the fact that some depend for the tension of the wire upon the tightness of the band, while another grasps the gavel in iron arms and the binding is done without special strain upon the wire or the twine.

D. M. Osborne's binding-reaper. (Figure 141.)

The Osborne machine has a palpably different motion to either of the others. It is made under the Gordon patents and has an upright post at the rear of the binding-table, to which the needle-arm above the table and the twister-arm below the table are attached; these arms have coincident motion, one describing a quadrant beneath the table and the other sweeping above in correspondence. The needle-arm has, however, an upward and downward sweep, so as in one direction to traverse free of the gavel which has accumulated, and in the downward motion to carry down the bight of the wire to a point of junction with the end which is held at the end of the twister-arm beneath the table.

Success of the machines in the field.

M. Teisserenc de Bort.

M. Eugène Tisserand.

The machine, in each case, was drawn by two horses, and the driver worked the machine without assistance. It was fully proved to the satisfaction of M. Teisserenc de Bort, the Minister of Agriculture and Commerce, and M. Eugène Tisserand, the Inspector-General of Agriculture of France, who followed each of the machines in company with the writer, the American juror of the class, that the binding-

Binding-reaper trials.

reaper was a perfect success, and that a machine with merely a driver was competent to go into a field and cut it all down, leaving it in bound sheaves, without any farther assistance.

D. M. Osborne's binding-reaper.

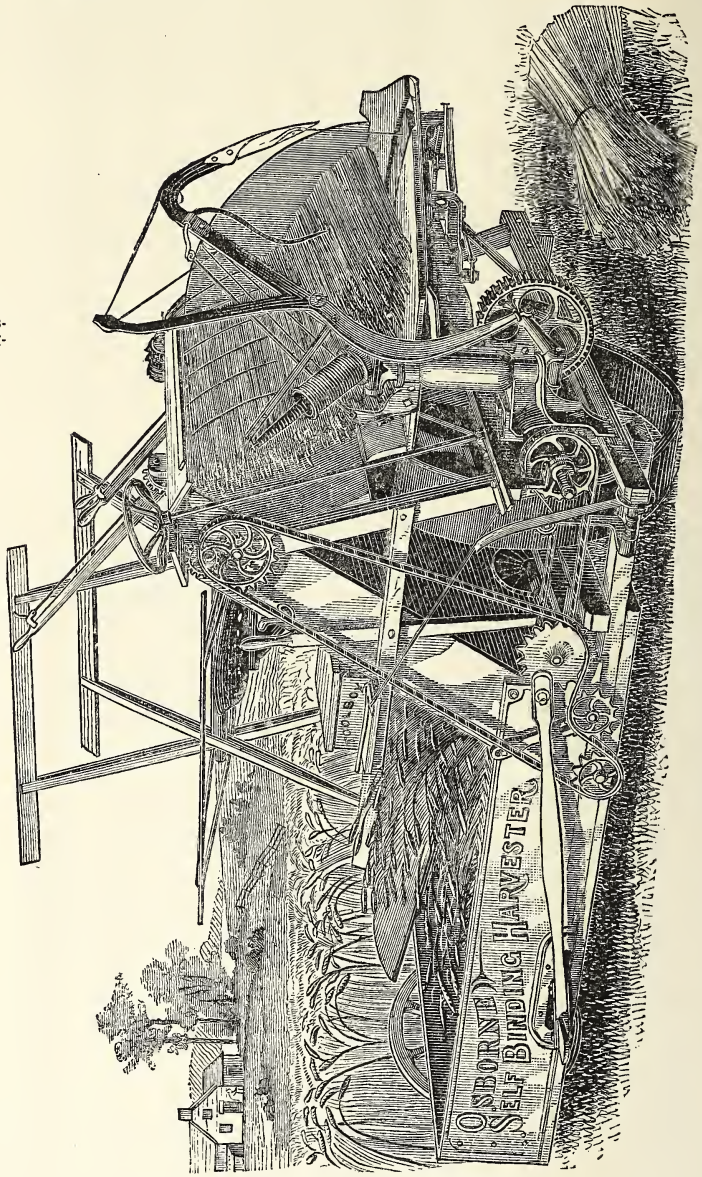


FIG. 141.—*Osborne binding-reaper (rear view).*

Attendance at the field trials.

The attendance at the trials was very large, French and foreign commissioners, members of the jury, committees from national and departmental societies of agriculture, exhibitors, and unofficial spectators. In the evening a ban-

quet was given in a tent on the grounds by M. Patinot, the Préfet of the department *Seine-et-Marne*, in whose jurisdiction the trials had taken place, and M. Teisserenc de Bort toasted the successful competitors. *Binding-reaper trials.* M. Patinot.

Three days afterward, the 25th, the trial on the three reaper-binders and also on the reapers and mowers was renewed, in order to test them dynamometrically.

Dynamometrical trials.

Dynamometrical trials.

The dynamometrical trials were under the care of a special committee, of which M. Tresca *fils*, of the *Conservatoire des Arts et Métiers*, was the chief, and the American juror, the writer of this report, a member. M. Tresca *fils*.

Three trials with each machine were had: Trials under three different conditions.

1. Running and cutting in the grain in regular order.

2. Running upon the ground not in grain, the cutting and binding apparatus in gear but the wire removed.

3. Running upon the ground, the cutting and binding apparatus not in gear.

The results of the dynamometrical tests and the proportions, weights, and prices of the machines are shown in the table annexed, as well as those of one of the sweep-rakes and four of the mowers, which were tested the same day, the 25th. Table, pages 134, 135.

It was much regretted by the jury that time did not permit similar testing of some other machines, especially the Champion single-wheel sweep-rake reaper which, like the Johnston sweep-rake machine, did such excellent work in grain which was as flat as if it had been rolled, and which the farmer owning the crop said it was absolutely impossible to cut with any machine. Tests of some machines omitted for want of time.

DYNAMOMETRICAL TRIALS OF REAPERS AND MOWERS

[Under the supervision of M. Eugène Tisserand, Inspector-General of Agri

Designation of machines.	Condition of machine: 1. At work, in grain or grass. 2. Mowing; mechanism in gear but not cutting. 3. Mowing; mechanism not in gear.	Surface of diagram, measured by the planimeter.	Length of trace on paper of dynamometer.	Mean ordinate.	Corresponding effort.	Width of cut.
		Square millimeters.	*Meters.*	*Millimeters.*	*Kilogrammeters.*	*Meters.*
Cyrus H. McCormick's binding-reaper ..	1	22,580	1.284	17.58	184.48	1.48
	2	*54,550	1.298	*43.03	128.49	1.48
	3	*43,160	1.386	*31.14	95.19	1.48
Walter A. Wood's binding-reaper	1	29,840	1.642	18.18	190.78	1.51
	2	38,270	3.059	12.51	131.28	1.51
	3	12,890	1.223	10.54	110.61	1.51
D. M. Osborne & Co.'s binding-reaper	1	20,560	1.225	16.73	176.09	1.58
	2	17,945	1.300	13.80	144.32	1.58
	3	11,100	1.206	9.22	96.75	1.58
Johnston Harvester Company's reaper ...	1	10,960	1.115	9.83	103.16	1.50
	2	6,290	1.002	6.28	65.90	1.50
	3	5,550	1.055	5.26	55.20	1.50
Aultman's mower, "Buckeye"	1	*20,900	0.721	*28.29	88.62	1.27
	2	*19,180	1.196	*16.04	49.03	1.27
	3	*16,070	1.148	*14.00	42.80	1.27
Warder & Mitchell's mower, "New Champion."	1 ††‡‡	*32,350	1.384	*23.28	71.47	1.28
	1 ‡‡	*22,820	0.880	*25.93	79.27	1.28
	2	*18,050	1.349	*13.89	42.46	1.28
	3	*10,860	0.936	*11.60	35.46	1.28
William Anson Wood's mower.....	1	*27,230	0.986	*27.52	84.13	1.28
	2	*19,280	0.558	*16.65	50.90	1.28
	3	*15,180	1.196	*13.53	41.36	1.28
Walter A. Wood's mower	1	*36,080	1.549	*23.29	71.20	1.29
	2	*23,970	1.363	*17.58	53.74	1.29
	3	*11,470	0.900	*12.74	38.95	1.29

Meter = 39.37079 inches, approximately $1\frac{1}{10}$ yards.
Millimeter, $\frac{1}{1000}$ meter = 0.0394 inch.
Kilo, *i. e.* kilogram = 1,000 grams = 2.2046 pounds avoirdupois, approximately $2\frac{1}{5}$ pounds.
Kilogrammeter = a force of 1 kilo exerted through 1 meter.
Hectare = 2.471 acres.

AT MARMONT (SEINE-ET-MARNE), FRANCE, JULY 25, 1878.

culture of France, and in connection with the Exposition at Paris, 1878.]

Effort corresponding to one meter of width of cut.	Length of course.	Time of course.	Rate of motion per second.	Stroke of knife.	Weight of machine.	Weight of driver.	Total weight.	Price of machine.	Estimate of power required to cut: †One hectare of wheat. ‡One hecture of luern.	Weight of wheat cut per square meter.	
Kilogram-meters.	*Meters.*	"	*Meters.*	*Meters.*	*Kilos.*	*Kilos.*	*Kilos.*	*Francs.*	*Kilogrammeters.*	*Kilos.*	
124.66	110	78.6	1.400	0.149	544	92	636	2,000			
86.82	110	77.4	1.290	0.149	544	92	636	2,000	† 1,246,600	0.8446	
64.32	110	83.4	1.320	0.149	544	92	636	2,000			
126.34	110	114.8	0.958	0.137	544	92	636	2,000			
86.94	110	119.0	0.924	0.137	544	92	636	2,000	† 1,263,400	0.7947	
73.35	110	86.0	1.280	0.137	544	92	636	2,000			
111.45	110	78.6	1.400	0.077	533	92	625	1,750			
91.66	110	92.2	1.193	0.077	533	92	625	1,750	† 1,114,500	0.8228	
61.63	110	75.6	1.455	0.077	533	92	625	1,750			
68.77	110	89.0	1.236	0.075	458	92	550	1,050			
43.93	110	84.3	1.305	0.075	458	92	550	1,050	† 687,700	0.8000	
36.80	110	80.2	1.372	0.075	458	92	550	1,050			
69.78	110	78.6	1.400	0.070	325	92	417	625			
38.61	110	92.2	1.109	0.070	325	92	417	625	‡ 697,800	.....	
33.70	110	95.0	1.158	0.070	325	92	417	625			
55.84	110	117.2	0.939	0.076	258	92	350	675			
61.93	110	117.4	0.937	0.076	258	92	350	675	‡ 619,300	.....	
33.17	110	110.2	0.998	0.076	258	92	350	675			
27.70	110	98.0	1.120	0.076	258	92	350	675			
65.73	110	81.2	1.122	0.070	295	92	387	675			
39.77	110	74.2	1.482	0.070	295	92	387	675	‡ 657,300	.....	
32.31	110	83.6	1.316	0.070	295	92	387	675			
55.99	110	99.4	1.107	0.069	254	92	346	675			
41.66	110	82.6	1.332	0.069	254	92	346	675	‡ 564,500	.....	
30.19	110	79.0	1.392	0.069	254	92	346	675			

Mean of work by the four reapers 0.8155 kilos per sq. meter = 8155 kilos per hectare.

Mean of work by the four mowers 1.355 kilos per sq. meter = 13,550 kilos per hectare.

* Essays marked thus * employed the dynamometer with the weaker springs; the other essays were with a more powerful instrument.

†† Ordinary height of stubble.

‡‡ Extra short stubble.

The dynamometer used was that belonging to the *Conservatoire des Arts et Métiers* of Paris. Tests and calculations by Professor Tresca *fils*, of the *Conservatoire*.

Binding-reaper trials.

Aultman machine.

The Aultman binder has a binding apparatus approximately the same as the Osborne, both being under the Gordon patents, and much regret was expressed at the accidental breakage which rendered it *hors concours*.

W. Anson Wood machine.

William Anson Wood had also a wire-binder of the Curtis patent, but the machine, though binding sheaves in the building, was not in fit order for the field.

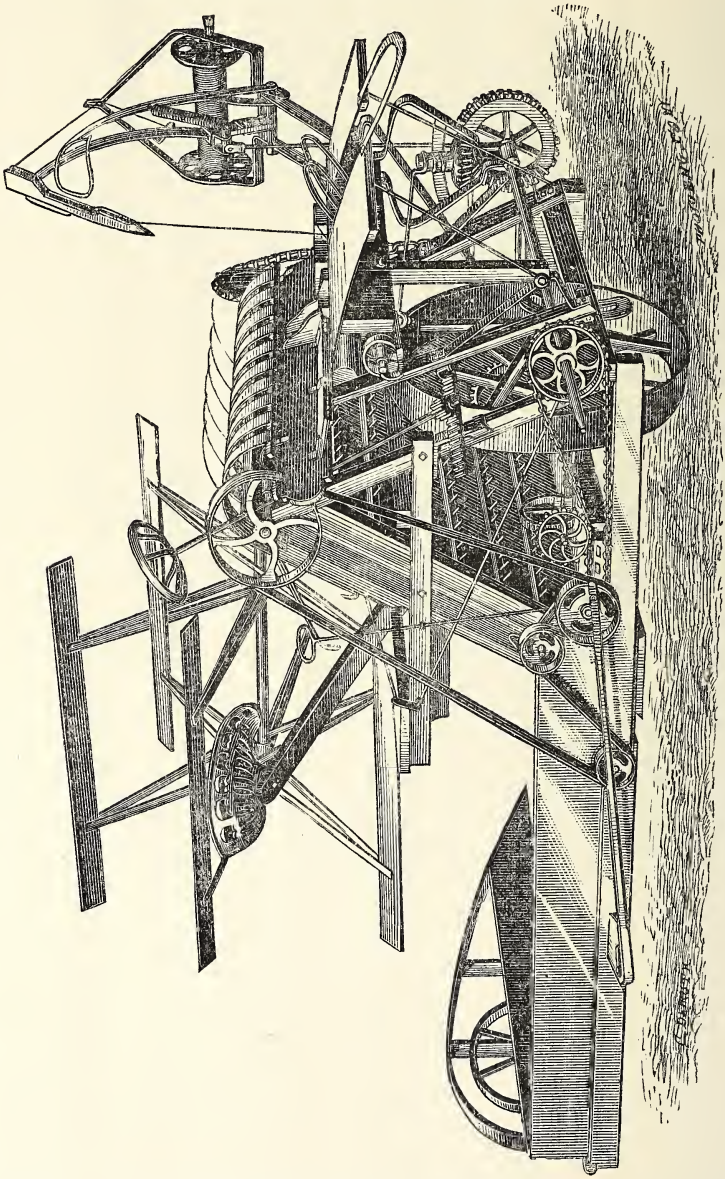


FIG. 142.—*Johnston Harvester Company's string-binding reaper (rear view).*

Johnston string-binder.

The string-binder of the Johnston Harvester Company makes a regular overhand knot, the doubled string being

given a round turn and rove through like the knot in a whip-lash. *Binding-reaper trials.*

The binding-arm has a traversing, horizontal and vertical, motion, at one side of the table. When the grain is fed over from the reaper, the binding-arm is at the extremity of its outward travel. The string is threaded from a reel supply carried on the binding-arm through the bill of the latter, and gripped in a clip below the table. When the grain comes on to the binding-table, the binding-arm is traversed forward and embraces the gavel with the string, which is then carried down to the gripping-clip below the table, where the other end is already attached. The knotting-shuttle then comes forward with a spiral twist, which pulls the loop through with a perfect overhand knot, cuts the string behind the knot, and regrips the string. The arm then travels back to the outside of the table, delivers the sheaf, and rises ready for the next one. This motion is very ingenious. The alternate traverse of the binding-arm is effected by means of a semi-toothed bevel-wheel with one-half face blank. This has a spur-gearing at its circumference. The main driving-wheel is well situated for receiving the principal weight of the machine, and gives an excellent balance. The machine has a carrying-wheel forward and another at the extremity of the cutting-tray. A gearing direct from the main driving-wheel impels the cutter-bar by means of the rocking-bar, which is pivoted under the middle of the sheaf-tray, and then takes hold of the cutter-bar in the center. A band from the circumference of the driving-disk works the elevating apparatus, which is of the usual finger-hook system. A chain-gearing drives the back counter-shaft, which operates the binding-arm. Suitable levers and treadles are placed near the driver, so that he can adjust the machine as he wishes. He can traverse the binding-tray over by means of a hand-wheel, so as to adapt the machine to any length of straw. A foot-trip enables him to stop the action of the binding-arm at pleasure, and thus hold up in thin places or around headlands, or, by a handle placed conveniently, he can throw the machine out of action entirely.

Johnston Harvester Company's string-binder. (Figure 142.)

Description and mode of operation.

Neale's English string-binder, shown by Ingrey in the English annex, was apparently never worked in the presence of parties who were supposed to know anything on the subject. It was stated to make a reef-knot. The method of delivering the cut grain to the secondary table where it was grasped by the binding-arm was very imperfect, and the whole affair is very unpromising.

Neale's English string-binder.

Binding-reaper trials.

Landelle's machine.

Landelle's wire-binding machine has been already referred to as invisible. From description it appears to be drawn by one horse alongside of the swath, the grain ascending a slightly inclined platform into the loop of the wire, when a swinging arm conducts the wire around it, brings the parts of the wire in contact, so that they may be twisted together and the wire cut. The end is left in a pair of grippers and the arm ascends.

The machine is intended to follow the reaper, to bind larger or smaller sheaves with a tightness superior to the ordinary hand work, and at such distance from the foot of the sheaf as may suit the length of straw.

Howard & Son's English wire-binder.

The English reaping-binder of Messrs. Howard & Son operates with wire, and is founded upon the Locke principle adopted by Mr. Walter A. Wood in his very successful machine.

Sheaf bands.

Sheaf-bands.

Two French hand-binds were shown in the Exposition annex on the Quai d'Orsay. Fig. 143 is a means of straining the string-band around the sheaf by means of a stick.

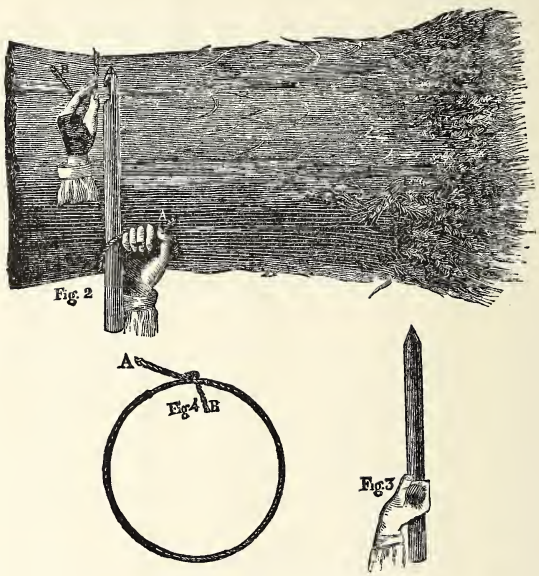


FIG. 143.—*Binding-stick.*

Hand binding-stick.

The band is composed of two cords knotted together, forming loops. The point of the tool (Fig. 143) is introduced through a loop at or near one end, and is thrust as far as the handle permits. The band being placed around the sheaf, the point of the tool is thrust through such one of

Binding-reaper trials.

the other loops as will give the tightness to the band, and the handle end of the tool is then carried over, describing an arc upon the point which is in the sheaf; the loop slips down from the handle to the point end, and the loop caught in the notch is then drawn through the loop on the stick, and the latter is withdrawn, allowing the knot drawn through to catch in the loop, where it is held by the expansion of the sheaf. The cords are 5′ long, and the price is, according to size, from $5.32 to $7.60 per 1,000.

Hand binding-stick.

In the French section were shown various attempts to obviate the use of the bunch of straw taken from the sheaf to form a band. One man proposes to use the bark peeled from osiers, two or three twisted together; these are sold very cheap. Another has cheap hempen strings cut to length and sold in bundles of one thousand each.

Use of osier bark and hempen strings for bands.

It is estimated that the annual crop of France is about 4,000,000,000 sheaves of grain, and that 50 straw bands contain one franc's worth of grain, the whole representing 80,000,000 fr., most of which is lost by shelling out on to the ground or mildewing under the band. Add to this the loss of time in making and applying, and the injury to the grain in the size of the band, which causes dampness to the sheaf. The figures seem formidable, and the *automatique* band is presented to solve the difficulty. The estimate is French, and in the interest of the hempen-band sellers; it is probably somewhat exaggerated.

Estimate of wheat lost in France in straw-binding.

One grain-band exhibited has a string attached to a block, and after passing around the sheaf rove through a ring. The mode of using it is evident from the engraving (Fig. 144); the wooden block being held in one hand, one knee of the operator is placed upon the sheaf to compress it, while the other hand draws the cord through the ring. The expansion of the sheaf pinches the cord between the ring and the block, and makes a perfectly tight fastening. The cord and block are treated with tar, and are smoked to render them indestructible by humidity and noxious to insects, rats, and lizards.

Hempen grain band and block.

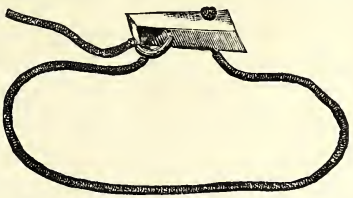


FIG. 144.—*Lapparent's automatic tie.*

The price is 70 fr. ($14) per 1,000, 5′ long.

Reference was made in page 14 to the action of the Minister of Public Instruction in placing 12 objects of art at the disposal of the Committee on Field Trials to reward exceptional merit which they might find in the competing

The special prizes for success in the field.

Binding-reaper trials.

machines. These rewards were independent of the regular Exposition prizes, and for "exceptional" merit, which term was held to embrace novelty.

Awards to binding-reapers and sweep-rake machines.

In consequence of this, each of the three binding-reapers received a special award, and two other harvesters whose work was so extraordinary in fallen grain and meritorious in construction, that they were held to be equally worthy of the award.

It was not intended to classify the machines by the respective values of the prizes, and all of them were alike—Sèvres vases valued at 1,000 fr. each.

Value of vases.

Many other excellent machines doing good work, but not beyond the ordinary run of superior implements of their class, were not included in these special awards.

Disposition of the objets d'art.

Disposition of the *objets d'art.*

Of the 12 *objets d'art* placed at the disposal of the committee, 11 were awarded, one to each of the following contestants:

The successful competitors.

Cyrus H. McCormick*	Chicago, Ill	Binding-reaper.
Walter A. Wood†	Hoosick Falls, N. Y	Binding-reaper.
D. M. Osborne & Co	Auburn, N. Y	Binding-reaper.
Johnston Harvester Co	Brockport, N. Y	Harvesters.
Warder, Mitchell, & Co., "Champion"	Springfield, Ohio	Harvesters.
Albaret & Co	Rantigny, France	Agricultural implements.
Deere & Co	Moline, Ill	Gang-plow.
Meixmoron de Dombasle	Nancy, France	Gang-plow.
Aveling & Porter	Rochester, England	Steam-plow.
S. Pilter (exhibitor)	Paris, France	Hay-press.
Dederick & Co	Albany, N. Y	Hay-press.

The number awarded to American inventors.

It would be invidious to lavish words on the subject of the proportion which American exhibitors obtained of these prizes; the number awarded to America speaks for itself. It may, however, be added, for a full appreciation of the matter, that the tenth on the list was awarded to the French exhibitor of the Dodge hay-press, an American invention, as was freely stated by M. Pilter, who exhibited it.

---

* Mr. Cyrus Hall McCormick was also made officer of the Legion of Honor, and elected a corresponding member of the Academy of Sciences, Institute of France.

Mr. Walter A. Wood was also made officer of the Legion of Honor.

Reaping-machine trials.

Reaping machines, simple and combined (that is, those for simply reaping, and those capable of being used either as reapers or mowers), were shown by exhibitors of five nations.

The work with these machines took place at Marmont on the same day with the binding-reapers just described. Five fields of wheat were appropriated to this work. [See map opposite page 120.] The condition of the grain varied very much in the different fields, and in different parts of the same field. Places were drawn by lot, and the lot in some cases sent machines into down grain or into heavy grain, with which they were entirely unable to cope, and a few machines were soon *hors de combat*, and practically withdrawn, as they ceased to work.

The field of Marmont, page 120.

It has been a common remark in Europe that the standing grain of America, grown on the low-culture system, and but light on the ground, might readily be cut with American machines, but for the heavy grain of the more highly cultivated European farms machines would require to be specially constructed.

American machines adapted to even the heaviest crops.

The chance of the lot sent some of our American machines into the flattest of the heavy wheat, which had been swept down by a storm after the heads were filled, and the result of the cutting only added to the surprise at the efficiency of the machines.

List of entries.

List of entries.

Of simple reapers and combined reapers and mowers the following entered the lists:

Number on the list.	Name.	Nation.	Number and nature of machine.	Location in the field.
1	Burgess & Key	London, Great Britain	1. Simple	Withdrawn.
2	Harrison, Macgregor, & Co.	Manchester, Great Britain.	do	Do.
3 to 6	Hornsby & Sons	Grantham, Great Britain	4. Simple	Do.
7	Picksley & Sims	Leigh, Great Britain	1. Simple	Do.
8 to 11	Samuelson & Co.	Banbury, Great Britain	4. Simple	Do.
12	John Watson	Ayr, Canada	1. Simple	G, 20.
13	Green Bros.	Waterford, Canada	do	G, 19.
14	William Anson Wood	Albany, United States	do	G, 24.
15	Aultman & Co.	Canton, Ohio, U. S.	do	G, 29.
16, 17	Johnston Harvester Co.	Brockport, N. Y., U. S.	2. Simple	C, 14. A, 3.
18, 19	D. M. Osborne & Co.	Auburn, N. Y., U. S	do	E, 17.
21, 22	Walter A. Wood	Hoosick Falls, N. Y., U. S.	do	J, 27. J, 29.
23	Warder, Mitchell, & Co.	Springfield, Ohio, U. S.	1. Simple	A, 5.

Reaping-machine trials. List of entries—(continued).

List of entries—(continued).

Number on the list.	Name.	Nation.	Number and nature of machine.	Location in the field.
24	Lilpop, Rau, & Co...	Varsovie, Russia	1. Simple...	E, 16.
25	Scholtze, Repphau, & Co.	.....do	....do	G, 21.
26	Albaret & Co	Rantigny, France	....do	E, 15.
27	Cumming	Orleans, France	....do	C, 10.
28	Henry	Abilly, France	....do	A, 1.
29	Hidien & Sons	Châteauroux, France	....do	J, 28.
30	Hurtu	Nangis, France	... do	C 9.
31	Leclèrc	Rouen, France	....do	A, 6.
37	Johnston Harvester Co.	Brockport, N. Y., U. S ..	1. Combined	A, 2.
38	D. M. Osborne & Co.	Auburn, N. Y., U. S.....	....do	C, 13.
39	Warder, Mitchell, & Co.	Springfield, Ohio, U. S..	....do	G, 26.

Specially good work by two machines.

It would take too long to follow the fortunes of all the instruments, and it would appear invidious to cite the failures, which were not many. Two machines did especially good work in heavy lodged grain, and quite a number did

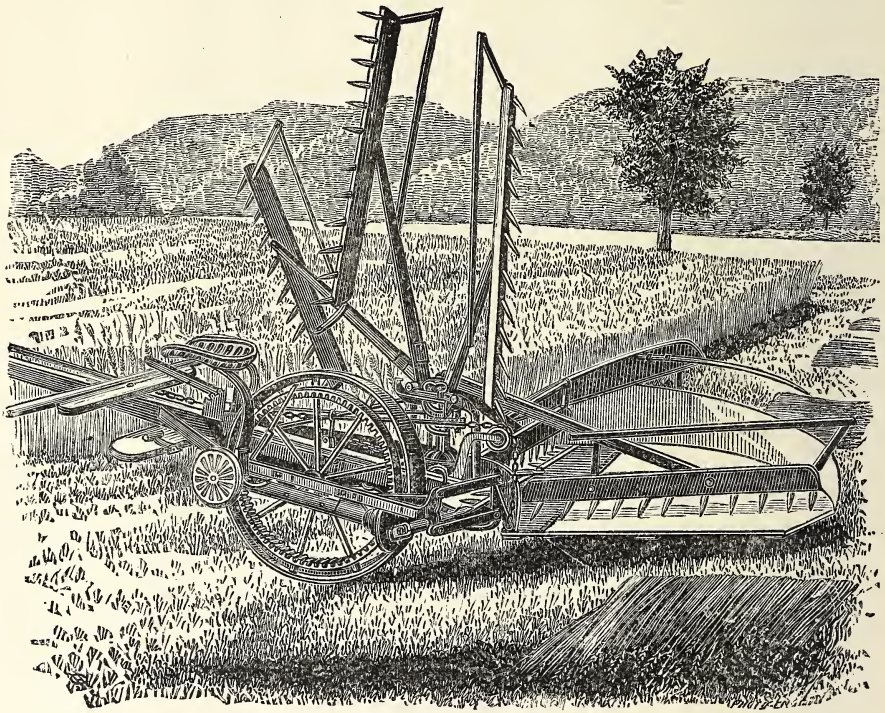


FIG. 145.—*Johnston Harvester Company's single-wheel sweep-rake reaper.*

good service in standing grain. Some of the latter failed, as might be expected, in fallen and curled spots. *Reaping-machine trials.*

By the terms of the order of the Minister of Agriculture and Commerce, the *objets d'art* were to be bestowed upon machines which manifested "exceptional merit" in the trials, and not for merely good or even excellent work under ordinary circumstances. It is not, therefore, saying too much when it is stated that the apparently unfortunate lot of some of the machines in having to deal with down grain tended, under the conditions of their entire success, to give them an exceptional approbation. Johnston single-wheel sweep-rake reaper.

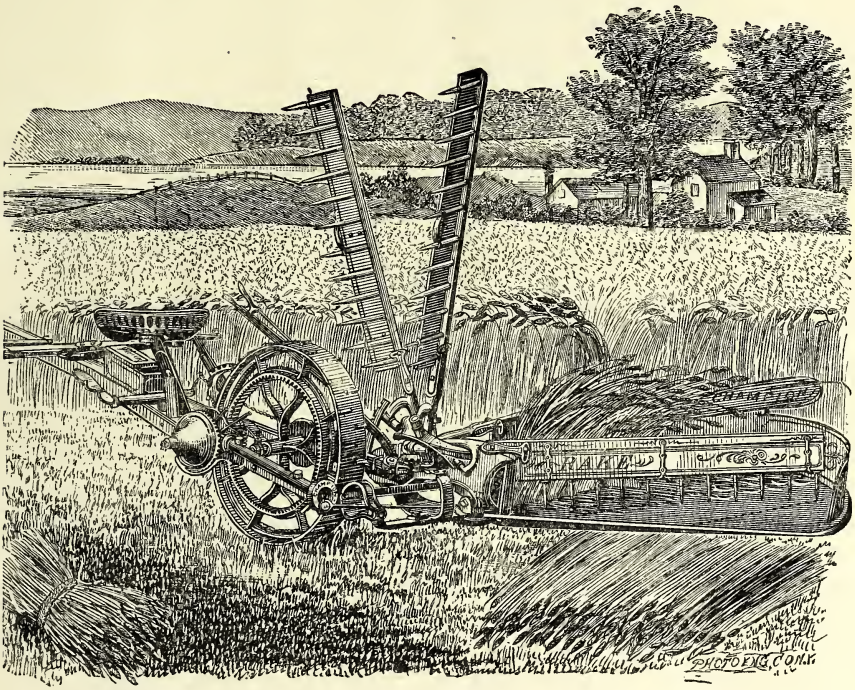


FIG. 146—*Warder, Mitchell, & Co.'s (Whiteley's "Champion") sweep-rake single-wheel reaper.*

The single-wheel sweep-rake reapers of the Johnston Harvester Company, of Lockport, N. Y., and of Warder, Mitchell, & Co. ("Champion"), of Springfield, Ohio, were both highly approved for their performances, and were selected for the dynamometrical trials which were to take place on a future day, and which were held on the 25th of July. The table showing the results of the tests is on pages 134, 135, and it may be added that the time required on that Warder, Mitchell, & Co. Whiteley's single-wheel sweep-rake reaper. Dynamometrical table, pages 134, 135.

Reaping-machine trials. day for making the series of trials, three tests under different conditions with each of eight machines, unfortunately prevented the inclusion of the "Champion" reaper.

The machines mentioned, of which cuts are given on pages 142, 143, are so familiar to all acquainted with the construction or operation of implements of this class that there is no need to occupy space in detailed description.

Condition of the grain in the field. The grain in field A (see map opposite page 120), where the two machines in question, and some others, worked, was much of it as flat as if a roller had passed over it, and great wonder was expressed at the manner in which the work was performed. The farmer upon whose grain the machine was to operate had previously remarked that he would agree to "eat any machine which could cut grain in such a condition," but it was done in very clean order, and the threat was not carried out.

Miller's "Buckeye" table-rake. The only novelty in the way of rakes—that is to say, which seemed to be a novelty to people generally in France, though well known in America—was Miller's Buckeye table-rake, which was also shown at Vienna in 1873. This table-rake and the dropper were the only variations from the sweep-rake now so general in Europe as well as in America.

Work of many other machines very satisfactory. The work of many other machines was very satisfactory, and the approval is manifest in the high-grade medals which they received from the Exposition jury. The test was made to enable the jury to determine by something more conclusive than merely viewing the machines in the buildings on the Champ de Mars, but as the machines are numerous and in general pretty well known, it is not thought necessary to give engravings of each.

Regrets at the withdrawal of the British machines. It probably occurred to many other members of the jury, as it did to the writer, to wonder why some of the excellent English machines were withdrawn from the competition after entering upon the roll.

Hornsby & Sons' This feeling was particularly expressed when viewing the reaping and mowing machines of Hornsby & Sons, of Grantham, England. Their machines were remarkably well designed and superbly finished, real works of art, and should by all means have been worked at the competitive trials.

The firm is on the alert, and states the following advantages as among their special improvements for 1878:

reaping machines. Late improvements. "New spring-slide for holding the connecting-rod in the knife, instead of the small bolt and nut, doing away with all loose parts connected with the knife and with the need for using a spanner.

"Improved leverage for raising the cutter-bar, much lighter in the lift than formerly.

"The connecting-rod is much improved, being made considerably stronger and more durable. *Reaping-machine trials.*

"The crank-pin is rendered easy of access, the unscrewing of a single nut *in front* of the crank-plate setting the rod at liberty.

"The in-and-out-of-gear-lever is now worked by a slight movement of the driver's foot, without need for him to leave his seat. Hornsby & Sons.

"The finger-bar is hinged, so as to be conveniently turned up for traveling, and, when turned up, is retained by a spring-catch.

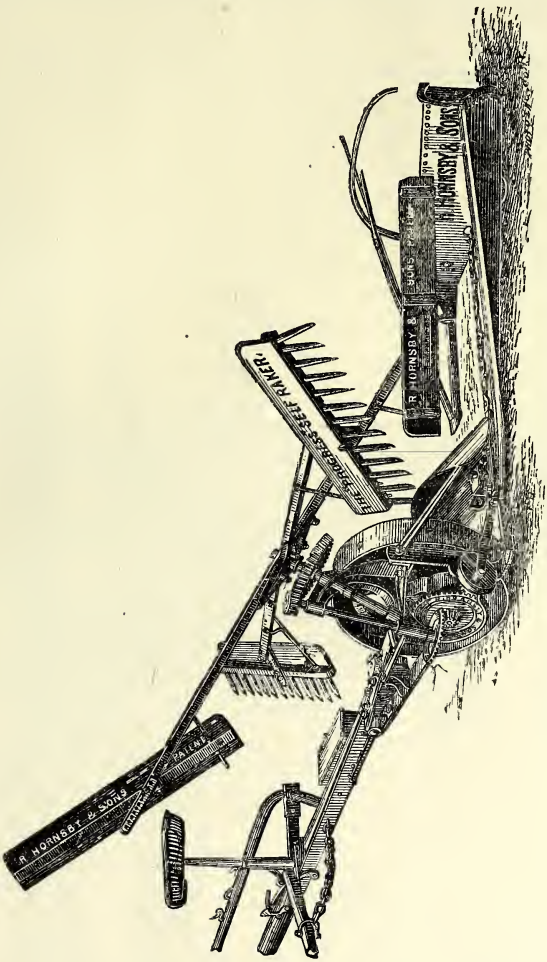


FIG. 147.—*Hornsby & Sons' "Progress" self-raker.*

"Progress" self-raker.

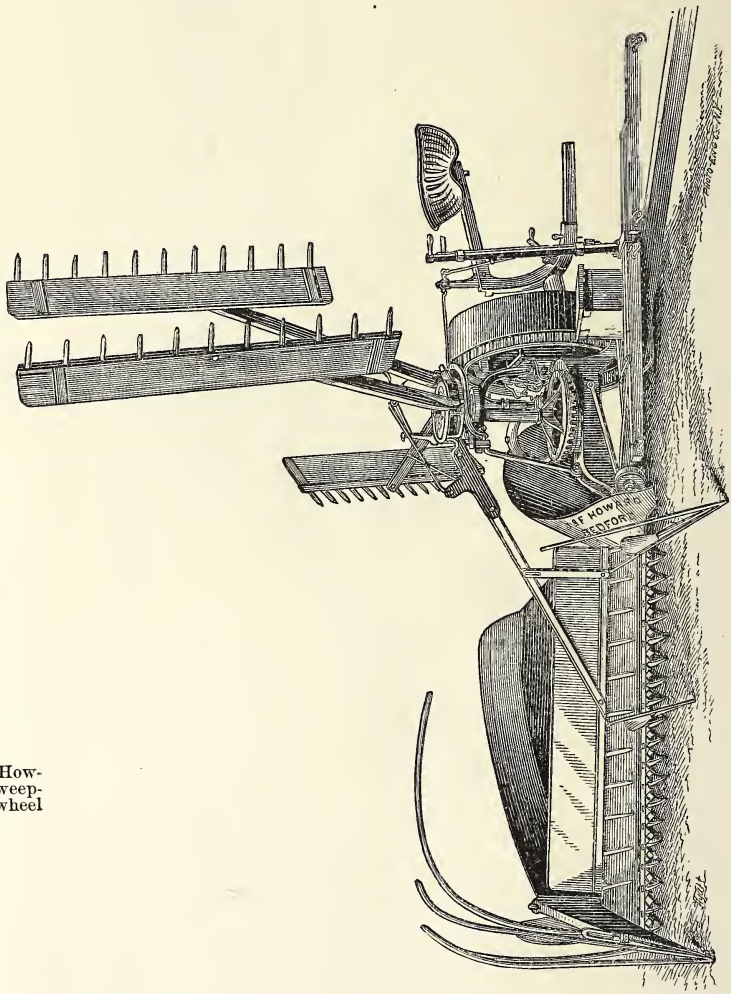
"The finger-bar can be raised to pass over the swathes. The side draught is overcome, and the weight of the pole taken off the horses' necks. All nuts are locked, to prevent them shaking loose. An entirely new pattern of frame, which is stronger, lighter, and more durable than hitherto. The cutting-bar is brought more in a line with the axle of the road-wheel than before, so as to ride more easily over inequalities of land. A new pattern of double-plated fingers, which allow all dirt to pass away without liability to clog the knives. Efficient oiling appliances to all bearings. In the combined machine the inconvenience of changing the pole-plate is now done away with, as no addi-

Reaping-machine trials.

tional pole-plate is required. The necessar change of position is effected by sliding the pole-plate along the patent bar provided for that purpose, and the alteration is easily and quickly made.

"An arrangement by which the driver, without leaving his seat, has complete control over the rakes, and can cause them to deliver the cut crop lying on the platform or pass over, leaving it untouched, to make a larger sheaf for delivery by the following or any other rake. The purpose of this arrangement is to enable the machine to deliver sheaves of equal size, though the crop may be of unequal density. The apparatus by which the rakes are controlled is simple and requires little supervision on the part of the man in charge of the machine, being provided with a register-bar, so that any number of the rakes desired become automatic without the intervention of the driver's foot as each successive rake passes."

Hornsby & Son's "Progress" self-raker. (Figure 147.)



J. & F. Howard's sweep-rake single-wheel reaper.

FIG. 148.—*J. & F. Howard's sweep-rake single-wheel reaper.*

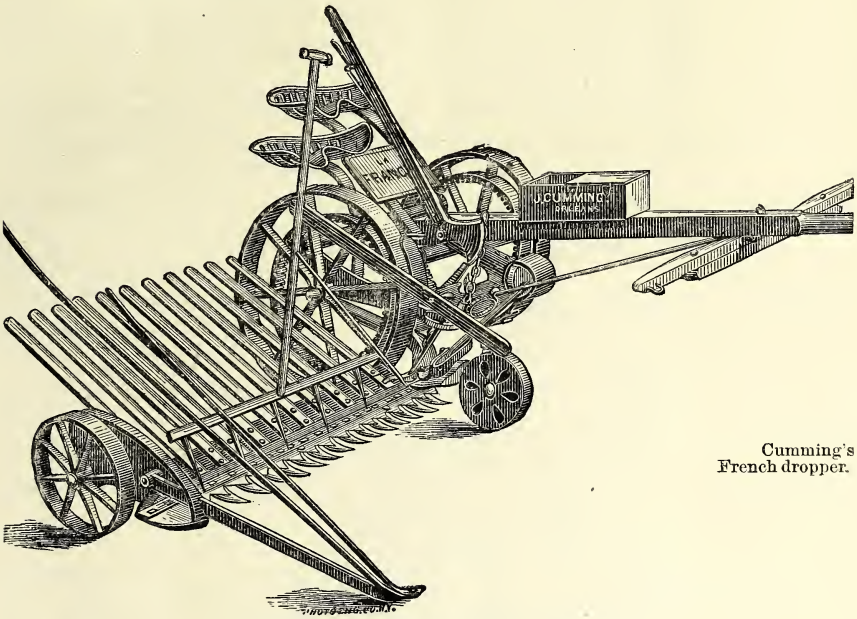
It will readily occur to one familiar with our own machines that some of the cited improvements have been

adopted in the United States for some time past. The improvements specified, as those of 1878, indicate the current condition of the manufacture of harvesting machines in England, by the enterprising and honorable firm of Hornsby & Sons. *Reaping-machine trials.*

The combined machines, 1-horse reapers and mowers for one and two horses, have equal excellence.

The machines made by J. & F. Howard, of Bedford, England, are also of high merit. Those of Samuelson & Co., of Banbury, struck the writer as probably abundantly strong enough for honest work, but heavy and ungraceful. J. & F. Howard's sweep-rake single-wheel reaper. (Figure 148.)

Seen anywhere, in the exhibit of any nation, the reaper is essentially American. The history has several times been written, and of course each nation forces its own heroes forward. National pride blinds even philosophers; witness Arago's absurd laudation of De Caus, and his *feuilleton* of the "Madman of Bicêtre."



Cumming's French dropper.

FIG. 149.—*Cumming's dropper (French).*

This is no place to enter upon lengthy general discussion, but *à propos* of the subject—reapers—the result of a careful comparison of the French reapers will serve to point the moral. Comparison of points in the French reapers with the American.

There were ten French exhibitors of harvesters at the Exposition, as follows: French exhibitors.

1. Liot, of Rouen.
2. Albaret, of Liancourt (*Oise*).

Reaping-machine trials. French exhibitors—(cont'd).

3. Limare, of Fécamp.
4. Cumming, of Orleans (Fig. 149).
5. Hurtu, of Nangis.
6. Pinet, of Abilly.
7. Hidien, of Châteauroux.
8. Renard, of Nantes. (Mower only.)
9. Palente, of Blangy-les-Arras.
10. Laelier, of Soissons.

Comparison of points in

The comparison following will apply in general to English machines also, and it is unnecessary to travel farther, for beyond the countries mentioned there is no competition worth mentioning. No reapers were shown from Spain, Portugal, Russia, Austria-Hungary, Switzerland, Belgium, or Holland.

The machines, then, are strictly on American models.

All the machines—reapers and mowers—have the horizontal straight cutter-bar projecting into the grain, the knife with triangular sections reciprocated horizontally in slotted guards by pitman and gear connection with the ground-wheel of the carriage.

Then, again, every one of them has a frame hinged directly to the axle of the carriage, or intermediately, to allow of the vertical adjustment of the height of cut.

Every one has a divider in the grain and a gathering-board at the carriage-side end of the finger-bar.

the French and American reapers exhibited.

Every reaper in the French section has a set of revolving sweep-rakes, controlled by the Johnston double cam and switch. Each one of them has also its adjustments by means of levers.

A number of the machines have the complete four adjustments, namely:

1. For raising the cutter to regulate the height of cut.
2. For giving more or less pitch to the guards relatively to the ground.
3. For operating the switch of the rake-cam.
4. For throwing in and out of gear with the drive-wheels.

All the machines have the last mentioned.

Nos. 1, 3, 6, and 7 of the list of firms have all the four adjustments.

Of the other features of the machines it may be mentioned that they are all right-hand cut, turning "gee," as we should say, though I own it is impossible to give an idea of the sounds which a French driver utters.

Of the reapers, Nos. 1, 3, 9, 10 are two-wheeled machines. The others (except 8, which is a mower) are single-wheeled.

Nos. 1, 2, 3, 6, 9, 10 are hind cut; Nos. 4, 5, 7, middle cut; that is, even with the main axle.

Reaping-machine trials.

The seats are nearly all well over to the near (left) side of the machine, and in some cases the driver's perch is on a hinged frame extending away out beyond the drive-wheel, and serving as a partial counterbalance. The hinged seats are in Nos. 4, 5, 7. No. 2, the "Persévérante," has a seat forward on the tongue between the horses.

Comparison of points in the French and American reapers exhibited.

No. 4 has a dropper, which was first invented by Ogle, in England, in 1822, but never came to anything. This was really a remarkable invention, as it had a reciprocating knife-bar drawn by horses in advance, cutter-bar projecting at the side, a reel to gather the grain to the knife, and a grain-platform which tilted to discharge the gavel. If it had only been better built and better appreciated, what a different history the reaper might have had! It was stillborn.

No. 4 (Fig. 149) had also—what I noticed among some English droppers—a second seat on the carriage for the raker. In some parts of the United States we do not consider a raker necessary with machines of this class. The slats of their droppers are about three inches wide, and with intervals between them less than their width. This may account for the need of a man to rake off. With us the slats are narrower, and when the dropper falls the heads of the grain catch in the stubble, and the gavel drags off easily and in good order. I notice, however, one American dropper with a raker's seat and rake. Cumming's machines are much above the average of the French.

Walter A. Wood's single-horse reaper.

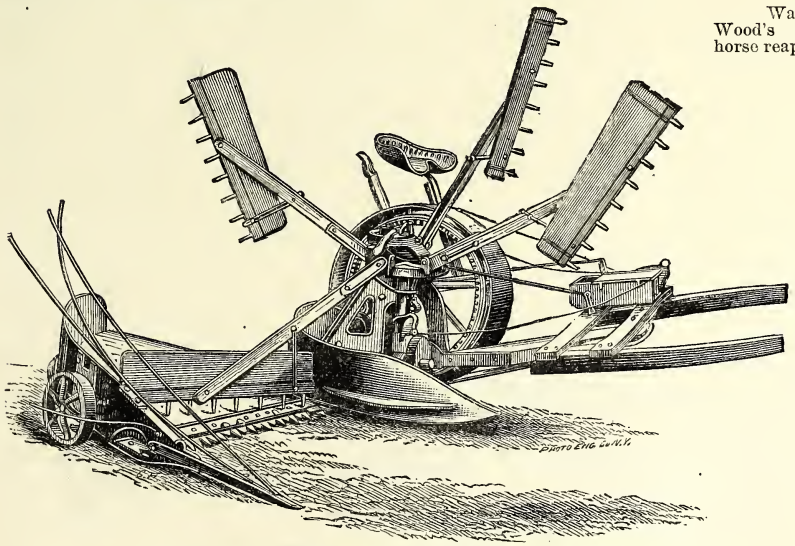


FIG. 150.—*Walter A. Wood's single-horse reaper.*

Hornsby & Sons.

Single-horse reapers were exhibited by several firms, the best being by Walter A. Wood, of the United States, and by Hornsby & Sons, of England.

The mowers worked in a 50-acre field of lucern, near the headquarters tent (see map opposite page 120) set up for the general management and for refreshments. The lucern was a second crop, and though not very light was so open in its growth as not to afford so severe a test as close grass with a woolly bottom. It is therefore needless to say that most of the machines worked satisfactorily and no exception could be taken. There were, however, some differences in the quality of the work and very great differences in the workmanship of the machines and in their mechanical design and construction.

Entries of mowers.

The mowers entered for the trials were as follows:

Number on the list.	Name.	Nation.	Location in in field.
41	Bamlett	Thirsk, Great Britain	Withdrawn.
42, 43	Harrison, MacGregor & Co	Manchester, Great Britain	28 and 23
44	John Watson	Ayr, Canada	2
45 to 47	Hornsby & Sons	Grantham, Great Britain	Withdrawn.
48	Lowcock & Barr	Shrewsbury, Great Britain	Do.
49	Picksley & Sims	Leigh, Great Britain	15
50 to 52	Samuelson & Co	Banbury, Great Britain	Withdrawn.
53	W. Anson Wood	Albany, N. Y., United States	30
54	Aultman & Co	Canton, Ohio, United States	3
55	Johnston Harvester Co	Brockport, N.Y., United States	1
56	McCormick & Co	Chicago, Ill., United States	Withdrawn.
57	D. M. Osborne & Co	Auburn, N. Y., United States	14
58, 59	Walter A. Wood	Hoosick Falls, N. Y., U. S	5 and 20
60, 61	Warder, Mitchell, & Co	Springfield, Ohio, U. S	7 and 21
62	Albaret & Co	Rantigny, France	22
63	Cumming	Orleans, France	9
64	Bodin	Rennes, France	Withdrawn.
65	Boucher & Co	Fumay, France	29
	Burgess & Key	London, Great Britain	19
66	Henry	Abilly, France	16
67	Hidien & Sons	Châteauroux, France	18
68	Hurtu	Nangis, France	10

"New Champion" mower. Warder, Mitchell, & Co.

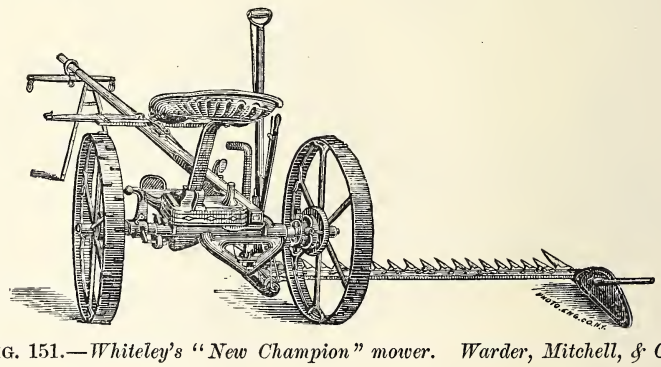
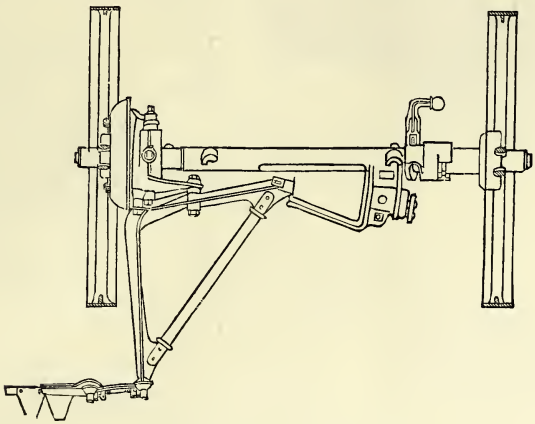


FIG. 151.—*Whiteley's "New Champion" mower. Warder, Mitchell, & Co.*

As was remarked in regard to reaping machines, the wealth of the show in mowers was so great that no detailed descrip-

tion can be given even of those the work of which was unimpeachable. *Mowing-machine trials.*

The most novel feature in the mowers exhibited in Paris was the working movement of the "New Champion" mower shown by Warder, Mitchell, & Co., of Springfield, Ohio. A Warder, Mitchell, & Co.



"New Champion" mower.

FIG. 152.—*Working movement of the "New Champion" mower.*

rear view of the machine is shown in Fig. 151, and a front view of the working movement in Fig. 152, the foot-board, seat, and tongue being removed. Fig. 153 is a view of the oscillating cog-gear.

This new principle dispenses with much of the ordinary machinery and gearing used in other mowing machines and embodies a new mechanical movement. There are practically but two pieces used between the main axle and the knife-pitman for communicating motion, one being a small bevel cog-wheel secured to the axle (seen on the left in Fig. 153), and the other a similar wheel secured to the frame and made to gear into the first. This second wheel—or disk—does not rotate, however, but, being hung on a gimbal-joint, it makes a succession of rapid, serpentine vibrations around the face of the other wheel; and an arm extending from this vibrating cogged disk down to the knife-pitman, and connected to the same by a ball-and-socket joint, gives the knife the required reciprocating motion. There is only one rotating bearing besides the main axle on the machine, and that is not a part of the movement proper, but supports a fly-wheel, which simply assists in giving the required regularity and steadiness of motion. Description of the structure and operation. Figures 151, 152, 153.

There are always 11 cogs in contact, thus distributing the wear over a large surface and reducing the strain, friction,

Mowing-machine trials.

and wear upon individual cogs. The machine runs smoothly and with but little noise.

"New Champion" mower.

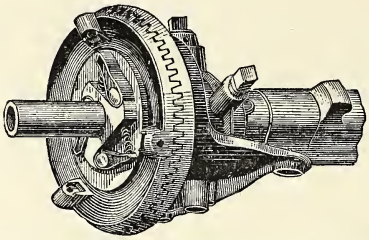


FIG. 153.—*Oscillating cog-gear of the "New Champion" mower.*

The "New Champion" mower has the four adjustments:

1. For putting in and out of gear.
2. Height of heel of cutter-bar.
3. Lifting the point of the bar.
4. Tipping the teeth.

The former "Champion" mower had but three of these adjustments, lacking the lift for the point of the bar.

Description and mode of operation. (Figure 151.)

The cutter-bar is operated and controlled by two levers, one for the foot and the other for the hand, and by the use of these levers either end of the cutter-bar may be thrown up at any angle or to a vertical position, all without throwing the machine out of gear or stopping the knife. The cutter-bar may also be folded and secured for transportation by the driver without leaving his seat, and by the use of the tilting-lever the height of cut may be changed and controlled instantly. By the use of this lever the cut may be lowered and the points of the guards turned down for picking up badly lodged grass, or the cut may be raised and the points of the guards turned up so as to cut high or readily pass over obstructions; or, when desired, the

Walter A. Wood's new mower. (See page 154.)

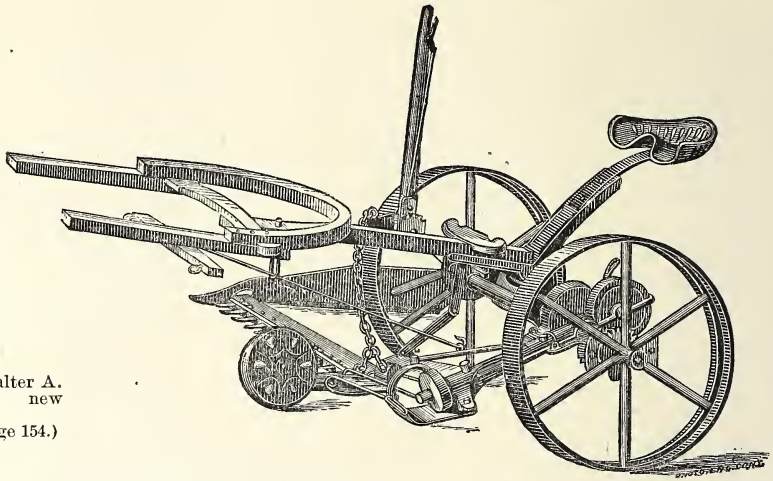
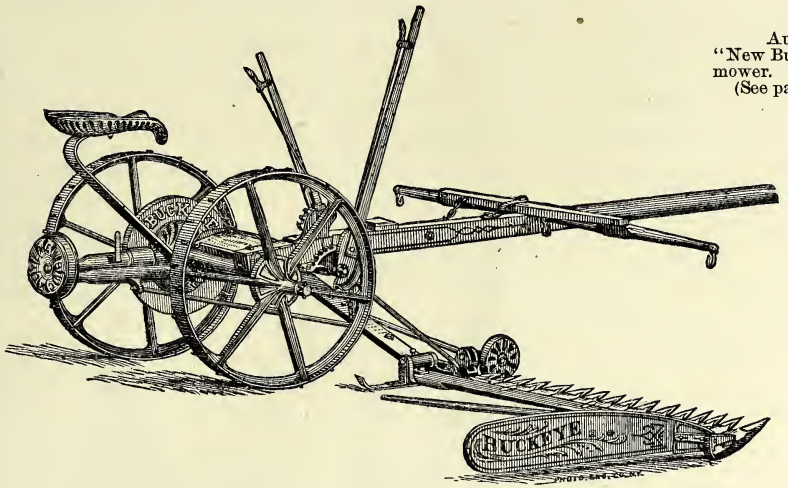


FIG. 154.—*Walter A. Wood's new mower (one-horse). (The machine tested was the two-horse machine with similar movement.)*

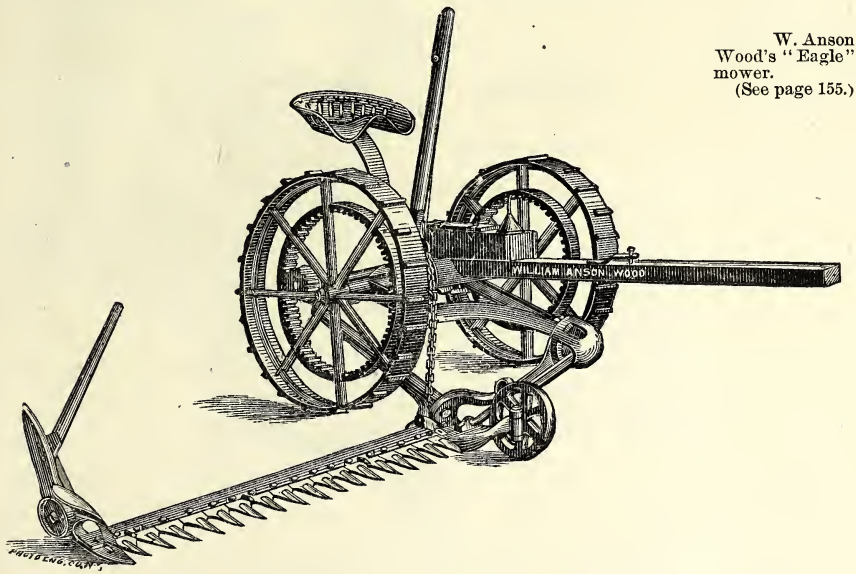
tilting-lever may be so arranged as to allow the cutter-bar and guards to oscillate and perfectly follow the uneven surface of the ground. *Mowing-machine trials.*



Aultman's "New Buckeye" mower.
(See page 155.)

FIG. 155.—*Aultman's "New Buckeye" mower.*

The draft of the team is not upon the pole, but through a draft-rod directly connected to the cutting apparatus in such a way that a portion of the weight of the finger-bar is



W. Anson Wood's "Eagle" mower.
(See page 155.)

FIG. 156.—*William Anson Wood's "Eagle" mower.*

carried or suspended by the draft of the team, leaving only a sufficient portion of the weight of the cutting apparatus upon the ground to secure smooth, clean cutting at any

Mowing-machine trials.

desired height. This arrangement also dispenses with the necessity of small carrying-wheels for the finger-bar.

The movers selected for the dynamometrical tests were two-horse machines; those of—

Mowers selected for the dynamometrical tests.

Warder, Mitchell, & Co., "New Champion."
Walter A. Wood (new mower).
Aultman & Co., "New Buckeye."
William Anson Wood, "Eagle."

The results are shown in the table on pages 134, 135.

Hornsby & Sons' English "Paragon" mower. (See page 155.)

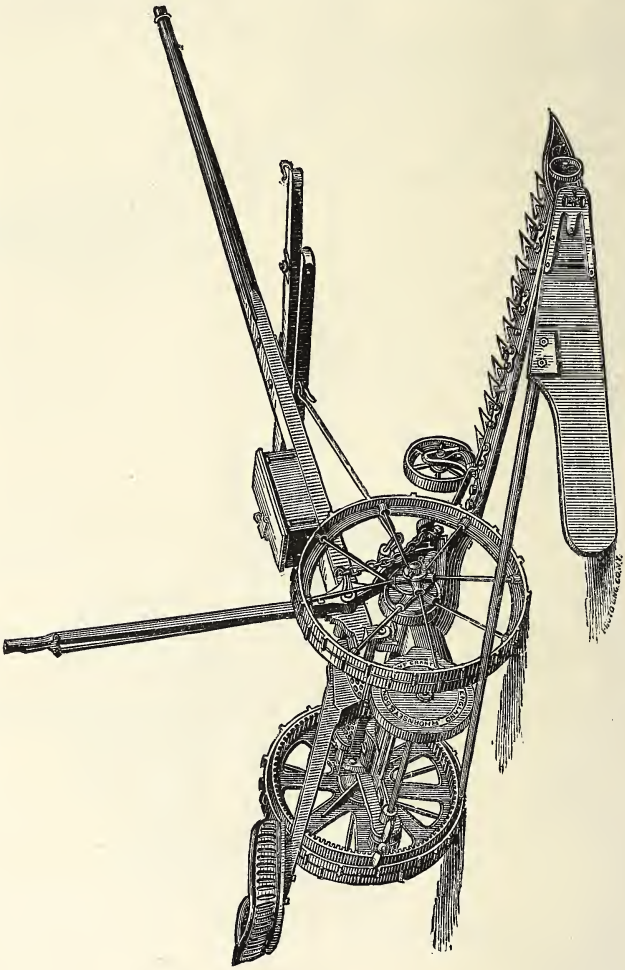


FIG. 157.—*Hornsby & Sons' "Paragon" mower.*

Walter A. Wood's new mower. (Figure 154.)

The machine of Walter A. Wood gave great satisfaction, the construction being remarkably simple and the workmanship excellent. The results, shown in the table, prove the simplicity of construction and the careful finish. Fig. 154 shows the machine as adapted to one horse, the functional

Mowing-machine trials.

parts being substantially the same in the two machines, differing in their proportions merely.

One-horse mowers.

There is probably more opening in Europe than in America for one-horse machines, inasmuch as the average size of holdings is smaller, and there are relatively more farmers there owning but a single horse.

"New Buckeye" mower. (Figure 155.)

The "Buckeye" mower (Fig. 155) is too well known and appreciated to require lengthy description. It and the "Eagle" mower (Fig. 156) were included in the dyanmometrical trials, and their record is on pages 134, 135. The Johnston, Osborne, and some other mowers worked well, and, had time permitted, might have well been included in the tests.

W. Anson Wood's "Eagle" mower. (Figure 156.)

Hornsby & Sons English "Paragon" mower. (Figure 157.)

Among the English mowers at the Exposition, unfortunately not at the trials, was the "Paragon" of Hornsby & Sons, of Grantham, England. So large a number of prizes have been taken in England by this machine that it would have been very interesting to have seen it in competition with the American. The records of the Taunton trials of the Royal Agricultural Society in 1875 give the highest commendation to this machine over all competitors in respect to lightness of draft.

Cumming's mower.

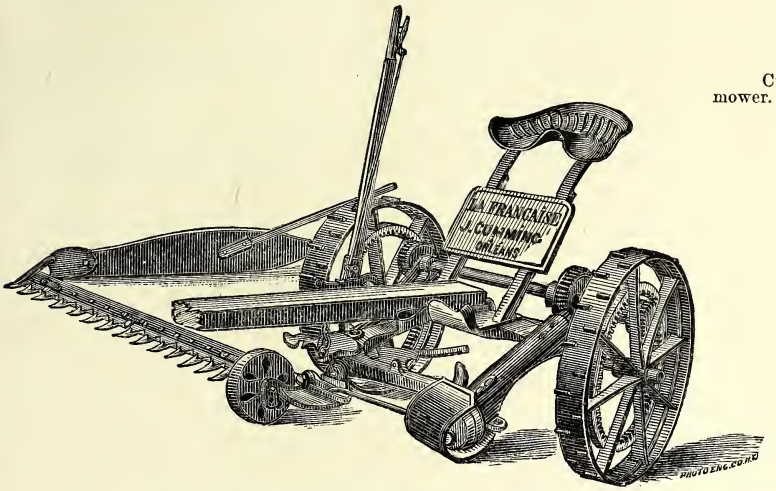


FIG. 158.—*Cumming's "La Française" mower.*

"*La Française.*"

The mower "*La Française*," made by Cumming & Co., of Orleans, France, was among the best of the French mowers, and reference should also be made to the machine of Bodin, of Rennes, but the French machines were decidedly inferior in style and workmanship to either the English or American.

Lawn-mowers, excellent in workmanship and effective in use, were exhibited by several American, English, and French firms. They were shown on the lawns of the Champ de Mars.

Archimedean-screw principle.

The differences between them were principally in size and in details, the general system of the spiral (so-called "Archimedean") knife being found in almost all. Some, however, had detachable and adjustable blades, which were preferred to those which only ground a sharp edge on the spiral flange. So also of the edge against which the spiral knife cut. Those in which this was a detachable blade were superior.

Exhibitors.

Among others, the following were exhibited:

Hill's "Archimedean" lawn-mower, Hartford, Conn.

Graham, Emlen, & Passmore's "Philadelphia," Philadelphia, Pa.

Lloyd, Supple, & Walton's "Pennsylvania," Philadelphia, Pa.

Chadborn & Coldwell's "Excelsior," Newburgh, N. Y.

Samuelson's "Favorite" and "Amateur," Banbury, England.

Picksley & Sim's, Leigh, near Manchester, England.

Several of these had boxes to contain the cut grass.

Aveling & Porter.

On the field of Marmont was exhibited, for the first time in France, the steam-reaper of Aveling & Porter, of Rochester, England. It consists of a wide-swath reaper, on the "Bell" principle, driven by a traction engine at its rear. It was a striking revival of the machine invented and used by the Rev. Patrick Bell, at Forfar, Scotland, in 1828, but cut a swath of 12 feet wide at the rate of 2½ miles per hour, over double the work of the Scotch machine. This was no extraordinary advance in point of economy, as the Bell machines worked with two horses and laid the swath in the same manner. The Aveling & Porter machine had a nominal power five or six times as great.

Bell's reaper, 1828.

Description and mode of operation of steam-reaper.

Like its prototype, the tongue of the machine extends to the rear, the power being behind, but, instead of a pair of horses hitched to the end of the tongue and facing their work, a 10 or 12 horse traction engine pushed the reaper into the grain, the cutting apparatus, grain-reel, and endless discharge-apron being worked by gearing driven by an endless chain from a sprocket-wheel or the fly-wheel shaft of the engine. The endless apron is inclined, and discharges the cut grain in a regular and continuous swath on the left of the machine, with the butts towards the engine and out of the way of the latter, which followed in the rear.

In front of the engine is a crane with tackle operatable from a drum, which may be thrown in connection with the engine when required. During the turning of corners while at work, and in transporting the apparatus to and from the field, the reaper is lifted and hangs' suspended from the crane.

The machine is operated and guided by one man, the various levers being conveniently placed; so that the reaper may be raised or lowered, the locomotive moved forward, backed, or guided to left or right, and the gearing which controls the functions of the reaper proper put into or out of operation.

Performance.

The machine did very good work, but it can hardly be said that it was regarded as of much practical value. The same objection was made to it that has always been justly urged against that form of steam-plow in which a moving locomotive drags the plows behind it over the ground. Without pretending to state accurately the relative proportions

Wrong principle.

Steam-reaper.

Aveling & Porter.

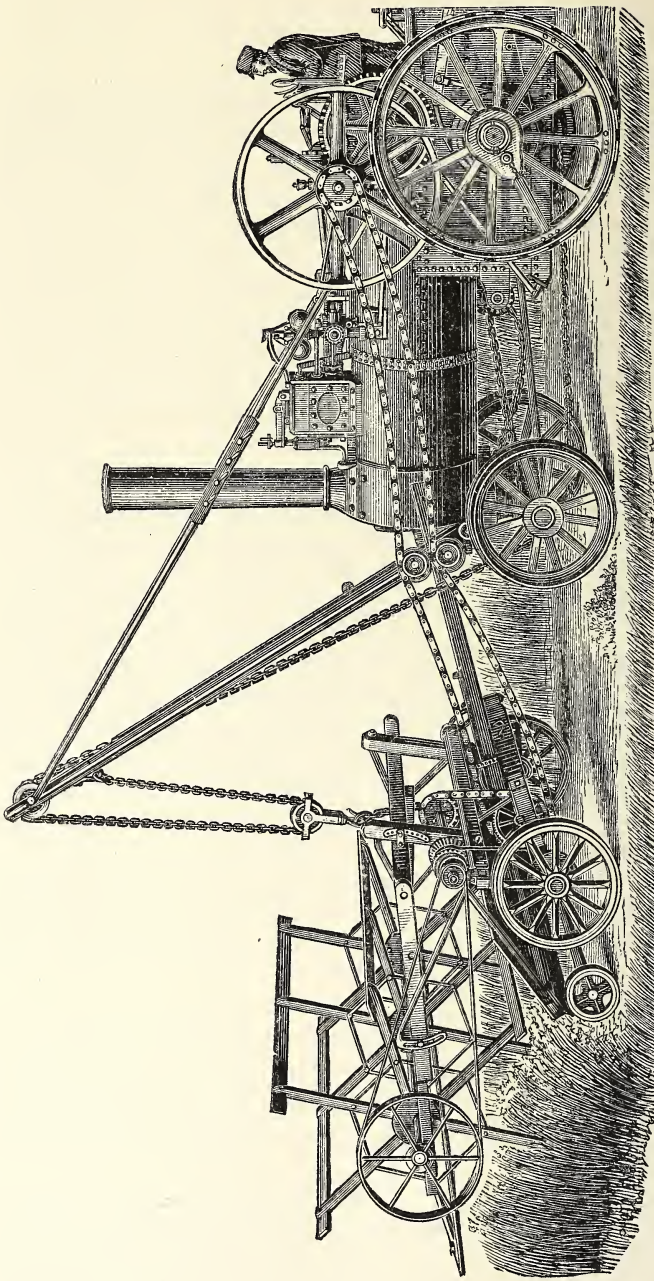


FIG. 159.—*Steam-reaper of Aveling & Porter.*

Steam-reaper. Aveling & Porter.

of the power which was exerted in moving the traction engine itself and in moving and operating the reaper proper, it was thought that less than one-half of the power exerted would have been sufficient to have cut a swath of the same width had the reaper been drawn by a wire rope on the roundabout method of installation, and which is sufficiently explained, for the present purpose, in the section treating of steam cultivation. (See pages 71 to 73.)

Comparison of moving-locomobile with the wire-rope system.

The agent remarked—what is the best that can be said for it—that it was not designed as the best reaper for a man who had to buy a reaper, but was intended for persons who use a *locomobile* on their farms for other purposes, and require an attachment to enable this engine to be useful in harvesting also. It requires a great deal of room at the corners to turn itself, but this difficulty vanishes when a couple of swaths have been cut around the field. For handy use in getting at down or lodged grain it is not a success.

Suggested conditions under which it may be useful.

The hay-tedders, horse-rakes, and hay-loaders entered for the trials were as follows:

Entries.

Number in the list.	Name.	Nation.	Nature of machine.
69, 70	Jeffrey & Blackstone	Stamford, Great Britain	Hay-tedder.
71, 72	Picksley, Sims, & Co.	Leigh, Great Britain	Horse hay-rake.
73	John Dodds	Dayton, Ohio, United States	Do.
74	Markt & Co	New York, United States	Do.
75	Stoddard & Co	Dayton, Ohio, United States	Do.
76	Pécard	Nevers, France	Do.
77 to 79	Petier	Paris, France	Do.
80	Coutelet & Sons	Étrepilly	Do.
83	Stratton & Cullom	Meadville, Pa., United States	Hay-loader.

Field of Marmont.

These were worked at Marmont upon the afternoon of the day on which the reapers operated, July 22, 1878, in the field of lucern which the mowers cut in the morning.

Comparison of European and American horse-rakes.

The French and English hay-rakes are heavier and more expensive than the American, and are usually all of iron. The round steel teeth of the American rakes are preferable to the flat bent bars of the European implements, are lighter, cheaper, and more pliable.

Guilleux's French horse-rake.

Fig. 160 shows a representative rake exhibited by Guilleux, of Segré (*Maine-et-Loire*), France. To dump the load the gang of teeth is tilted, the front ends downward; clearing-bars are in the alternate spaces between the teeth. The tilting-lever projects far over to the rear; the operator

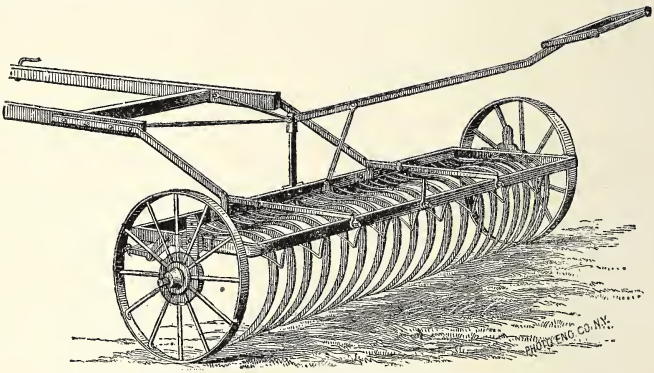


FIG. 160.—*Horse-rake. C. Guilleux, Segré, France.*

Price.

walks behind. The implement is all of iron. The price is, with 20 teeth, 180 fr.; with 28 teeth, 270 fr.; and there are three sizes between these limits.

The English firm of Picksley, Sims, & Co. exhibited the *flop-over* rake as "the American;" but the United States

horse hay-rakes were well represented by John Dodds, B. C. Taylor, and J. W. Stoddard & Co., all of Dayton, Ohio; the Bay State Rake Company, of Winchendon, Mass.; Coates & Co., of Alliance, Ohio; and Markt & Co., of New York. *Horse-rakes, etc.* American exhibitors.

Fig. 161 is a French riding horse-rake, made by Lhuillier, of Dijon (*Côte d'Or*). It has a friction-band on the hub, brought into action by a foot-lever, to tilt the rake and discharge the load by the revolution of the wheel. Lhuillier's

The prices of Lhuillier's rakes range as follows: French horse-rake.

	Francs.
24 teeth, with seat	260
26 teeth, with seat	280
28 teeth, with seat	300

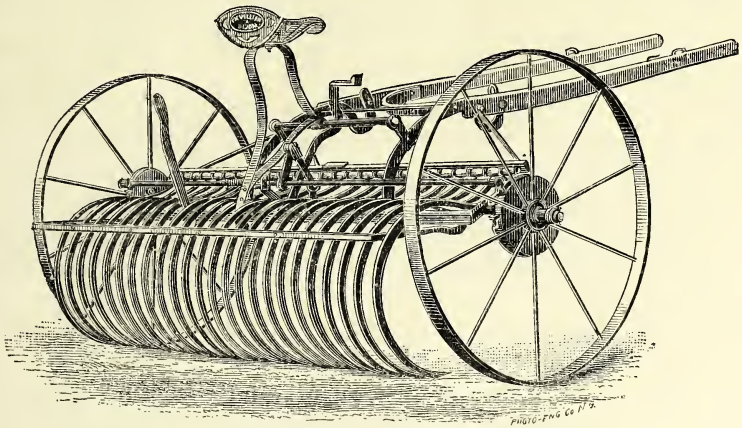


FIG. 161.—*Riding horse-rake. Lhuillier, Dijon, France.*

The self-discharging apparatus is found in quite a number of American rakes; those of Markt & Co., of New York; Self-discharging apparatus.

Howard's English horse-rake.

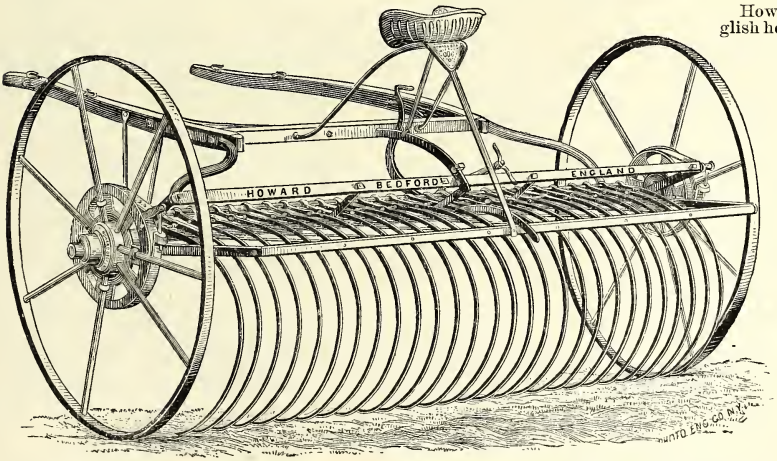


FIG. 162.—*Self-dumping riding horse-rake. James & Frederick Howard, Bedford, England.*

Horse-rakes, etc. Self-discharging apparatus.

Stoddard & Co., of Dayton, Ohio; Bickford & Huffman, of Macedon, N. Y., and some others. The friction-band is also used on the Howard riding rake of Bedford, England, as in Fig. 162.

Howard's rake (Figure 162).

The prices of Howard's rakes vary with the number of teeth, the width of the machine, the diameter of the wheels, and the weight.

Sizes and prices.

Number of teeth.	Width of machine.	Diameter of wheels.	Weight.	Price.
	Feet.	*Inches.*	*Pounds.*	£. s. d.
24	7½	42	588	10 10 0
28	8½	42	616	11 0 0
24	7½	52	644	12 10 0
28	8½	57	784	14 0 0

The wheels are of wrought iron and the teeth of fluted steel.

Action of rake.

When used as a riding rake the load is dumped by a foot-lever, which brings a friction-brake into action, causing the rake-head to make a portion of a revolution around the axle, tipping up the gang of rake-teeth and discharging the load.

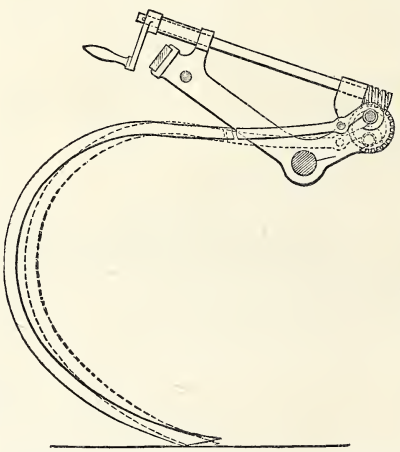
The clearer-rods, six in number, reach from the axle to the rear horizontal bar, on which the hind leg of the seat is supported.

When the operator is walking behind, the brake is operated by a hand-lever.

Anglo-American horse-rake.

The so-called "Anglo-American" rake shown by Howard & Co., of Bedford, England, bears a strong similarity to the above. It has the clearer-bars projecting rearwardly from the wooden axle, the self-dumping brake arrangement, and is sold in England for £7 10*s*. The implement has 24 teeth, 52″ wrought-iron wheels, is 8½′ wide, and weighs 450 lbs. The 24-tooth, 52″-wheel, 7½′ wide English machine weighs 644 lbs., and is quoted at £12 10*s*.

Howard's self-dumping rake.



Adjusting the pitch of the teeth.

FIG. 163.—*Howard's system of adjusting horse-rake teeth.*

Howard's self-dumping horse-rake has a method for adjusting the pitch of the teeth to suit the nature of the crop and the state of the ground.

When the land is soft or loose, the teeth, if set as shown in black lines, will skim the surface without collecting rub-

bish. By turning the handle, the teeth can be made to rake in any intermediate position, or brought up to the extreme pitch shown by the dotted lines. For ordinary work the pitch is adjusted midway between the extremes of the movement.

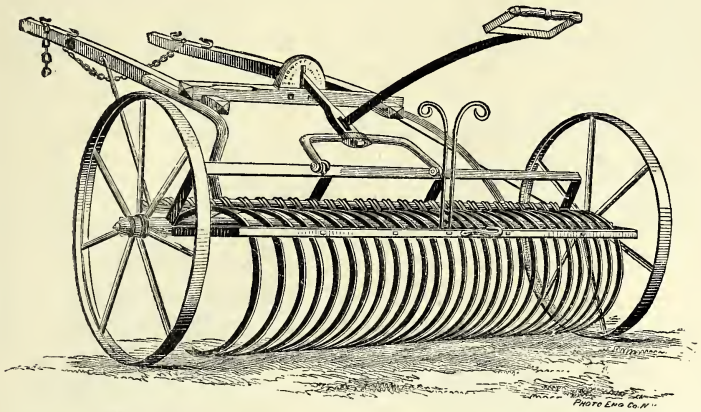
Horse-rakes, etc. Adjustment of the teeth.

In raking stubbles, the teeth can be raised by the shifting-stop on the quadrant, so as to run quite clear of the ground.

Howard's rake (Figure 163).

The Ransome rake (English) is also self-dumping.

Ransome's rake.



Walking hay-rake, J. & F. Howard.

FIG. 164.—*Walking hay-rake. James & Frederick Howard, Bedford, England.*

Howard's walking hay-rake is one of the most substantial of its class, and is made of various sizes.

Turning rake Riches & Watts.

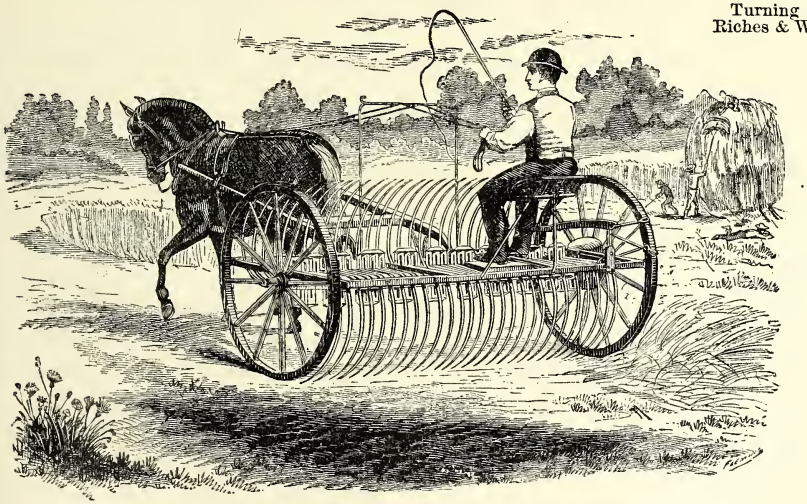


FIG. 165.—*Turning rake. Riches & Watts, Norwich, England.*

Teeth, 24 to 28; wheels, diameter, 32″ to 42″; width, 7½′ to 8½′; weight, 4½ to 5½ cwt.; price, £9 5*s*. to £10 15*s*.

Prices of Howard's rake.

Horse-rakes, etc. Howard's rake (Figure 164).

The shafts are attached to the central axle, which also forms a fulcrum on which the teeth, when being raised, are balanced. The pitch of the teeth is altered by means of the regulating-holes in the radius-bar which passes through the name-plate.

Turning rake, Riches & Watts (Figure 165).

A turning rake on a wheeled axle was exhibited by Riches & Watts, of Norwich, England. The discharge is made by pressing a foot-lever at the right of the seat, when the tooth-axle is disengaged and the loaded rake revolves to the rear, discharging the load. Having accomplished half a revolution, the foot being removed from the lever, the other rake is arrested at its working position and the work is resumed. The absence of shock as the rakes fall into position is particularly urged as an advantage.

Price.

The price is from £21 to £24.

A reversible rake, in which the length of the rake can be thrown in line with the shafts to enable the machine to pass

Reversible horse-rake.

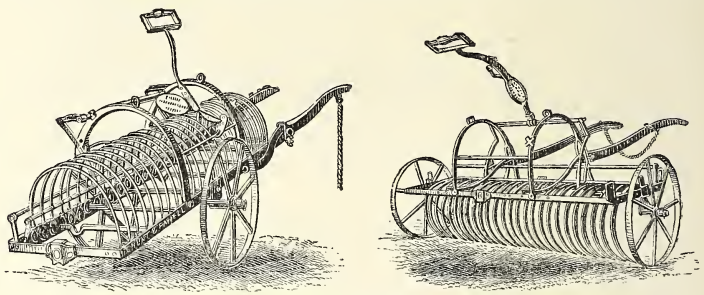


FIG. 166.—*Reversible horse-rake.*

narrow gateways and doorways, was shown in the French section.

Hollingsworth horse-rake, John Dodds (Figure 167).

Of the American rakes exhibited may be mentioned the Hollingsworth horse hay-rake (Fig. 167), made by John Dodds, of Dayton, Ohio, which obtained the gold medal for simplicity and efficiency, after trials in the field, raking green lucern of the second growth, at Marmont, near Paris, July 22, 1878.

Description.

The teeth are independent, and may be set any distance from the ground by slipping them endwise, each being held by its own jam-screw. They are thus set up for gleaning and set down for meadow work. This also admits of drawing the end teeth forward of those in the center, so as to gather the hay inward and prevent its scattering out at the ends. The upper end of each tooth plays upon a spiral spring, which allows the point to rise and pass an obstruction. It is operated by hand and foot lever.

Horse-rakes, etc. Bay State Rake Company.

The rake exhibited by the Bay State Rake Company, of Winchendon, Mass., is self-dumping, that is to say, a foot-lever connects temporarily the rake-head with the wheels, so that the onward motion of the wheels dumps the load. It dumps from both wheels, and is operated entirely by the foot. The teeth at each end are brought forward of those in the center, so that it has a tendency to roll the hay in-

Dodd's horse-rake.

FIG. 167.—*Hollingsworth horse hay-rake. John Dodd, Dayton, Ohio.*

ward and prevent its roping out at the ends. The lateral stay of each tooth limits the side motion, and each tooth is independent, so that it can pass an obstacle without interfering with the normal action of adjacent teeth. It obtained a silver medal.

Taylor rake.

The Taylor rake, made at Dayton, Ohio, is a hand-lever operating rake.

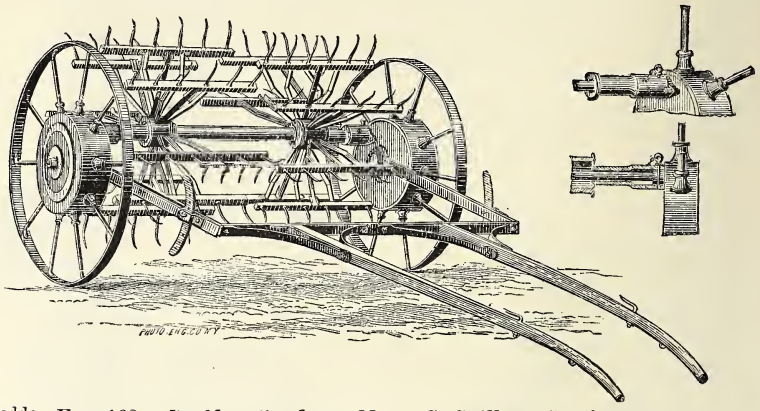
"Tiger" rake, Stoddard & Co.

The "Tiger" rake, made and exhibited by Stoddard & Co., of Dayton, Ohio, is a self-discharging rake, dumping from both wheels. The discharge is accomplished by pressing the foot upon a chain conveniently arranged for that purpose, and the teeth are thereby locked to the rotating axle and, after being tilted and the contents discharged by the movement of the horse, are automatically released and resume their work.

Hay-tedder.

The hay-tedder (French, *faneuse*), for stirring cut grass in the field to give access of sun and air, is an implement much used in the humid climate of Europe, but of comparatively

Horse-rakes, etc. little value to us. Single and double acting hay-tedders were exhibited by Guilleux, of Segré, and Bodin, of Trois-



Hay-tedder, Guilleux, FIG. 168.—*Double-acting hay-tedder. C. Guilleux, Segré, France.*

Croix, Rennes, the latter implement being on the principle Bodin. of that made by Howard, of England.

The price varied from 425 to 500 fr.

Hay-tedder.

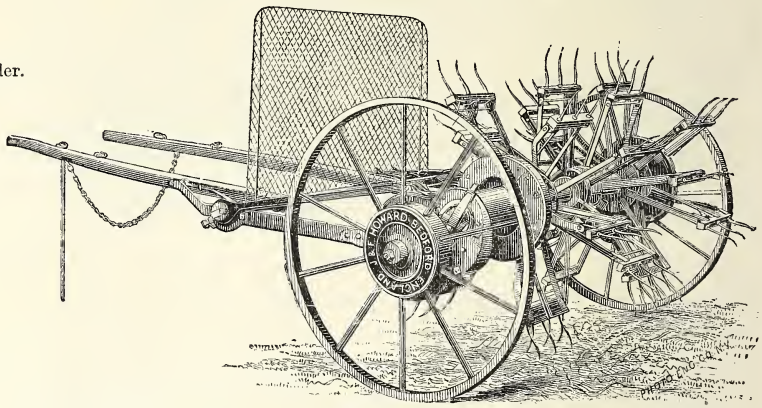


FIG. 169.—*Hay-tedder. James & Frederick Howard, Bedford, England.*

J. & F. Howard. In one hay-tedder built by Howard, of Bedford, England, the forks are disposed in zigzag order, four series of three teeth each, so that the work is practically uniform. The throwing in and out of gear is by means of a lever placed on the side out of danger of contact of the forks with the Description. arm of the operator. The two systems of forks are regulated at such height from the ground as may suit the condition of the crop. The fork-heads revolve at a rapid rate, and the wire netting is to catch the hay and prevent it from covering the horse. By an eccentric movement of the main axle the rakes can be changed from a forward to a backward action, or *vice versa*.

Price. Price, 525 fr.; wire netting, 25 fr. extra.

TRIALS AT THE ESPLANADE DES INVALIDES.

Trials at the Esplanade des Invalides.

HORSE-POWERS.

Horse-powers.

While the agricultural engines were remitted to the jury on steam-engines, etc. (Class 54), the horse-powers were examined along with thrashing machines, in connection with which, indeed, is their principal use on a farm.

Abundance of small horse-powers in France.

A person unacquainted with French farming and homesteads might, from the style and predominating size and force of the horse-powers, arrive at the correct conclusion that on French farms of very moderate pretensions horse-powers are kept and used. With us the thrashing of a farm is generally done by parties who own machines of large capacity, driven by 8 or 10-horse powers or portable engines, and taken to the farms of a neighborhood, *seriatim*, thrashing at so much per bushel.

European uses of straw.

The European practice is generally different, the straw being valued for feed or for sale in trusses, and not, as with us, made into a large rick, to which the cattle have free access; the result of which latter is that they eat some, tear out a great deal, and trample it all under foot, eventually forming a very fair quality of manure.

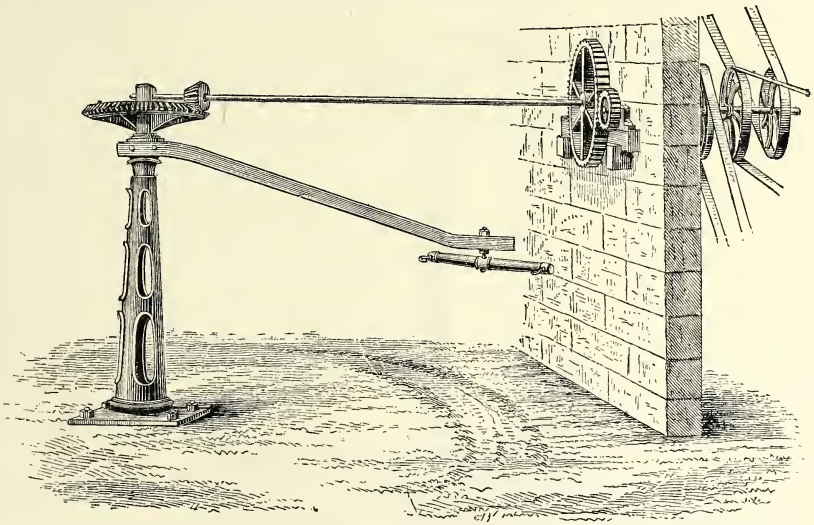


FIG. 170.—*One-horse overhead horse-power. T. Gautreau, Dourdan, France.*

One-horse power. Gautreau.

A large number and variety of horse-powers for 1 or 2 horses were shown at the Exposition. The larger kinds, used mounted or dismounted, and with spur-wheels and

Horse-powers. pinions or bevel-gearing, are much like our own, but the smaller kinds and types may perhaps suggest some ideas of

French horse-power, with overhead-rod.

Gautreau.

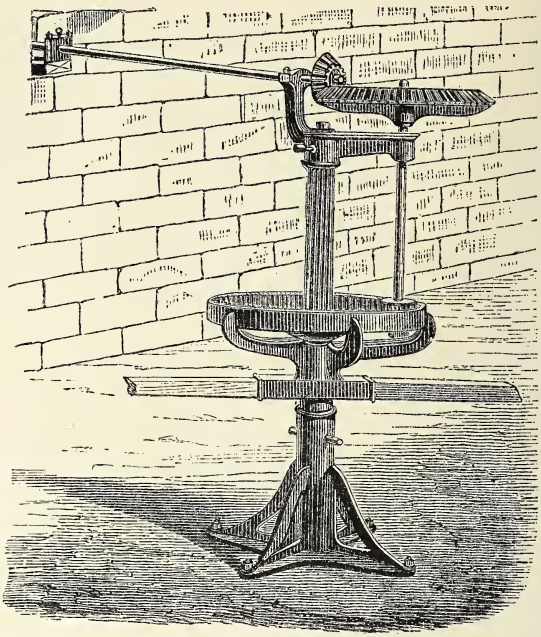


FIG. 171.—*Vertical horse-power with overhead-rod. T. Gautreau, Dourdan, France.*

French horse-power, with overhead band.

Gautreau.

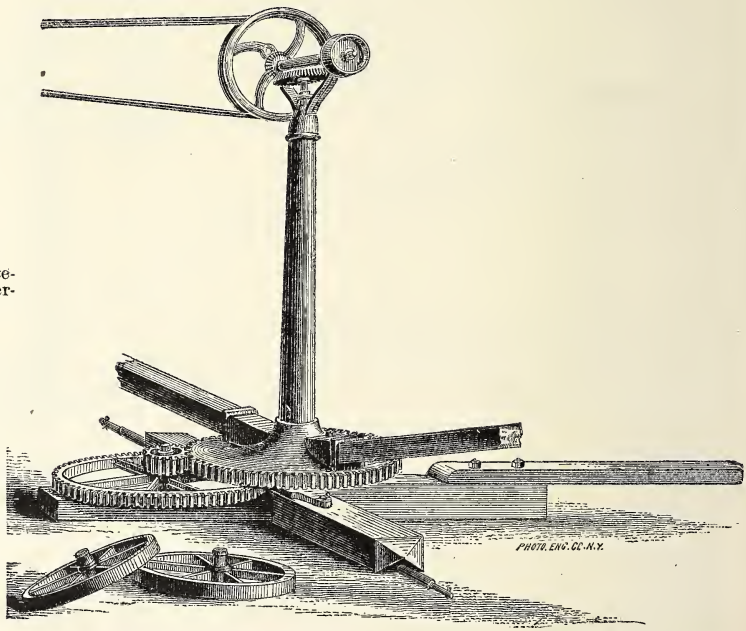


FIG. 172.—*Overhead columnar horse-power with band-wheel. T. Gautreau, Dourdan, France.*

value to us, as horse-powers of moderate size are deserving of more consideration among us than they receive either from makers or farmers. *Horse-powers.*

The small horse-power with shafting, Fig. 170, by Gautreau, of Dourdan (*Seine-et-Oise*), France, is founded on a column, the connecting-shaft going overhead. The horse-power stands on the outside of the building, and the power is transmitted by a bevel master-wheel and pinion, spur-wheel, and pinion to the pulley-shaft, which latter has a speed of 60 revolutions per minute with an ordinary speed of the horse which is attached to the sweep. Gautreau (Figure 170).

From the shafts in the building different *instruments d'intérieur*, as they are termed, are operated. Such are the straw-cutter, root-washer, root-cutter, grain-bruiser, etc.

The column is simply bolted to a foundation-plate or pillar and the wall-gearing and shafting to a wall-plate, with but little expense of fitting, the work being simply to line and level the shafting in boxes already prepared and easily attached in place.

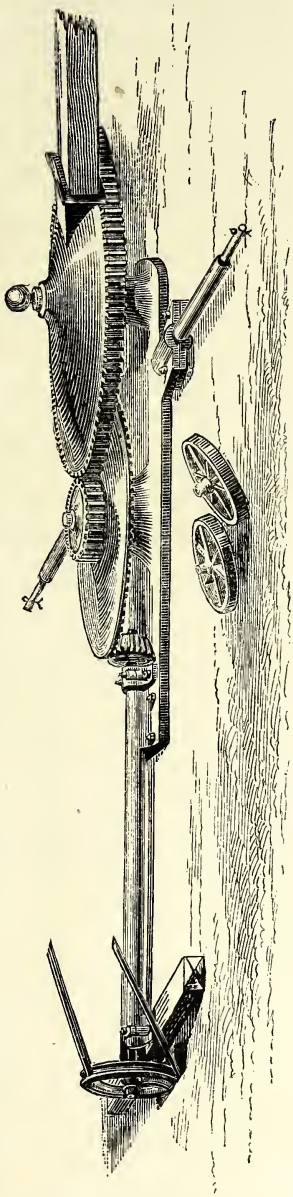


FIG. 173.—*Horse-power with ground-rod. T. Gautreau, Dourdan, France.*

Gautreau's ground-rod horse-power.

Fig. 171 is another form of pillar horse-power with pinion in internal spur-wheel and bevel-gears above, the shaft passing through a wall to the machinery in the interior of the building. Overhead-rod horse-power (Figure 171).

Fig. 172 is another form of columnar horse-power, adapted for one or two horses. It is one of the lightest and cheapest forms. Overhead-band horse-power (Figure 172).

The head is movable on the neck of the column, so as to direct the band-wheel in any radial direction from the column as an axis. It may thus be made to do duty with either one in turn of a numerous series of machines in a cir-

Horse-powers. Gautreau's horse-power (Figure 172).

cular arrangement around the horse-power as a center, such as a chaff-cutter, root-cutter, corn-sheller, cider-mill, churn, or what not.

The speed-multiplier is an arrangement of spur-gears and pinions on the cruciform foot-frame, which is anchored or staked to the ground or bolted to a floor.

The pulley revolving in a vertical plane has one advantage over the horizontal pulley, as it allows the endless band to reach a machine whose driving-pulley is much below that on the column, whereas the horizontal pulley requires that the machines shall have a relative height.

It is transported by sufficiently elevating it to enable wheels to be slipped upon the spindles, which are shown projecting from the ends of two opposite bars of the cruciform frame. To one of the bars at right angles to the last stated is attached the tongue to which the team is geared for transporting the horse-power; or the tongue is attached to the rear of the thrasher.

The pulley-shaft may be prolonged by means of a coupling, so as to penetrate the wall of a building for the conveyance of power.

Gautreau's ground-rod horse-power (Figure 173).

The forms of under-foot rods are as various as the overhead arrangements. In Fig. 173 the bed-plate carries the gearing and has a pair of spindles for the transporting-wheels, as in the last-mentioned case. The lever to which the horse is attached is locked in position to form a tongue. The connecting-rod leads to a pulley on a small supplementary frame.

Other forms of horse-powers, mounted and unmounted, are shown in the section which treats of thrashing machines (which follows).

The above machines, as well as those to which reference has just been made, are constructed by Gautreau, of Dourdan, France.

THRASHING MACHINES.

Thrashing machines.

Thrashing machines were in great force at the Exposition. The English exhibitors were thirteen in number, the French still more numerous. There were three from the United States.

Essential difference between the American and European machines.

The American style of machine is not adapted for the English and French markets. In both of these countries the straw is preserved straight and as nearly as possible unbroken, and is usually trussed for sale. It is true that great quantities, in England especially, are merely tramped into manure in the cattle yards, but the straw market is an important one, and machines that beat it to pieces, as ours do, are not popular, although for feed it is better after passing through an American machine.

Uses of straw in England and France.

American peg-drum system.

There is one main constructive difference between the machines. The American drum has spikes and follows the fashion of the old peg-drum, the wheat being fed in endways, heads in front. The British machine has flat beaters, like the vanes of a fanning mill, and the straw is fed in flatways, its length extending across the machine, so that it is delivered comparatively straight. The difference is irreconcilable. The American is the more efficient and rapid machine, as was fairly shown in a test in 1853 at Mr. Alderman Mechi's farm, Tiptree Hall, Essex, England. The writer accompanied the American machine to the spot. As long as the important market for straight straw exists, the American peg-drum system will be unpopular for large-sized machines.

British beater system.

Trials at Kelvedon, England, 1853, Mr. Mechi.

The same remarks apply to the French machines and systems of working.

French small machines with peg-drums.

In a small class of machines—those run by hand or by one or two horses—the peg-drum system is, however, found in England and France, the thrashing being generally done in small quantities at a time, the straw being used for feed or for litter, the former principally.

Machines for Southern Europe, Africa, etc.;

In the South of Europe, Egypt, and Mexico—all of which are purchasers of English machines—the peg-drum system is much the better, as the straw stands in place of hay for feeding horses and cattle. Meadows are practically unknown in many Mediterranean countries. It was also remarked to the writer, while in Paris, by a Russian proprietor, that the American system was the best for their country, as the more

For Russia.

Thrashing machines.

the straw was bruised the softer it was for food and the quicker it rotted when spread in the barnyard.

Straw-burning attachment, Ransomes, Sims & Head.

Ransomes, Sims & Head have an attachment to their thrashing machine for Spain, Italy, Egypt, and Mexico by which the straw is chopped and bruised as it comes from the thrasher. The result is to assimilate the straw to the condition obtained by the old process of tramping out the grain by driving cattle over a flooring of sheaves or by the sled (the *tribulum* of the Romans), still used in every country bordering upon the Mediterranean.

French hand thrashing machine, Texier & Sons.

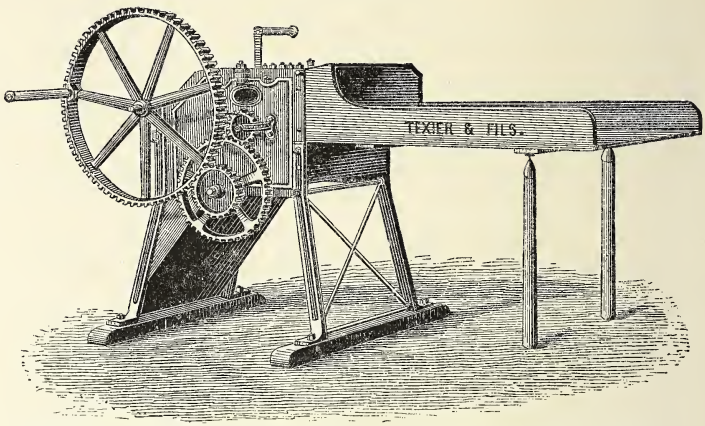


FIG. 174.—*Hand thrashing machine. Texier & Fils, Vitré, France.*

Price.

Fig. 174 shows a French hand-power thrasher, made for 160 fr. It has a peg-drum and no cleaning apparatus. The

French 1-horse-power thrashing machine, Gautreau.

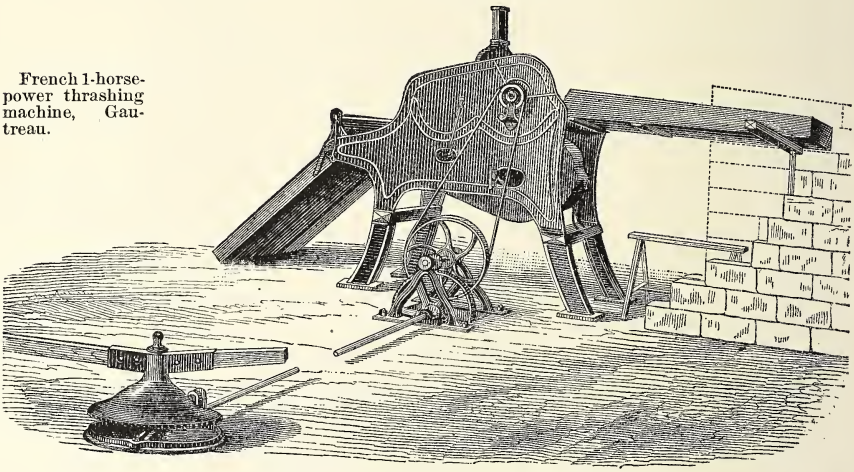


FIG. 175.—*French 1-horse-power thrasher.*

speed-multiplying gearing shows clearly at the side, and the results of the operation slide down the inclined grating, the

wheat and much of the chaff falling through the interstices. The casing of the machine is of sheet-iron.

Thrashing machines.

French 1-horse-power thrasher (Figure 175).

Fig. 175 is a power machine of small class, the horse-power being adapted for one horse or two ponies. It thrashes, separates the straw, fans away the chaff, and sacks the grain. It is light, cheap, easily placed, and requires but moderate force to operate it. The duty is 40 to 50 sheaves, of 10 kilos each, per hour.

The principal portion of the multiplying-gearing stands by the thrasher.

French portable thrasher with mounted horse-power (Figure 176).

Fig. 176 is a still larger sized thrasher, for two or three horses. The thrasher is mounted on a cart and has the grain cleaning and bagging arrangements. The horse-power is mounted upon a truck, and on the top of the column is the band-wheel. The framing of the machine is of iron and the casing of sheet-iron.

The beaters of the drum are on the English principle to conserve the straw.

Gautreau.

It is made by Gautreau, of Dourdan, as is the previous example.

French type of machines.

The powerful machines of large class are usually driven by portable engines, both in England and France, the agricultural engine being much more commonly used in those countries than with us. The machines shown in Figs. 175 and 176 are not closely like any out of France, but with their larger machines the French follow the English model, and consequently they are both unlike our own.

British thrashing machine (Figure 177).

Ruston, Proctor, & Co.

Fig. 177 shows Ruston, Proctor, & Co.'s thrashing machine of large size. Machines of this class do their work well, take a good deal of power, are very heavy and clumsy, but deliver the grain, chaff, straw, tailings in good separated condition, and, what is unusual with us, sort the sound grain into several different qualities. They are not rapid, but, to express it in few words, are ponderous and effective. The weight of the large class of machines, such as represented, varies from 6,600 to 8,580 lbs. avoirdupois! It rather astonished some of the manufacturers during the trial at Mr. Mechi's, before mentioned, when, an inquiry having been made as to the weight of the American machine, the writer lifted one corner of the machine by raising one wheel from the ground. Yet the machine had just thrashed and cleaned 448 bushels of barley in 6 hours, in the presence of 150 persons, and had done it better than any English machine was then capable of doing. The London "Times," in its issue of the next morning (in November, 1853), mentioned the work, its editor, Mr. Mowbray Morris,

Large and heavy.

Comparative efficiency of American and English machines.

Mr. Mowbray Morris.

Thrashing machines.

French portable thrashing machine, with mounted horse-power. Gautreau.

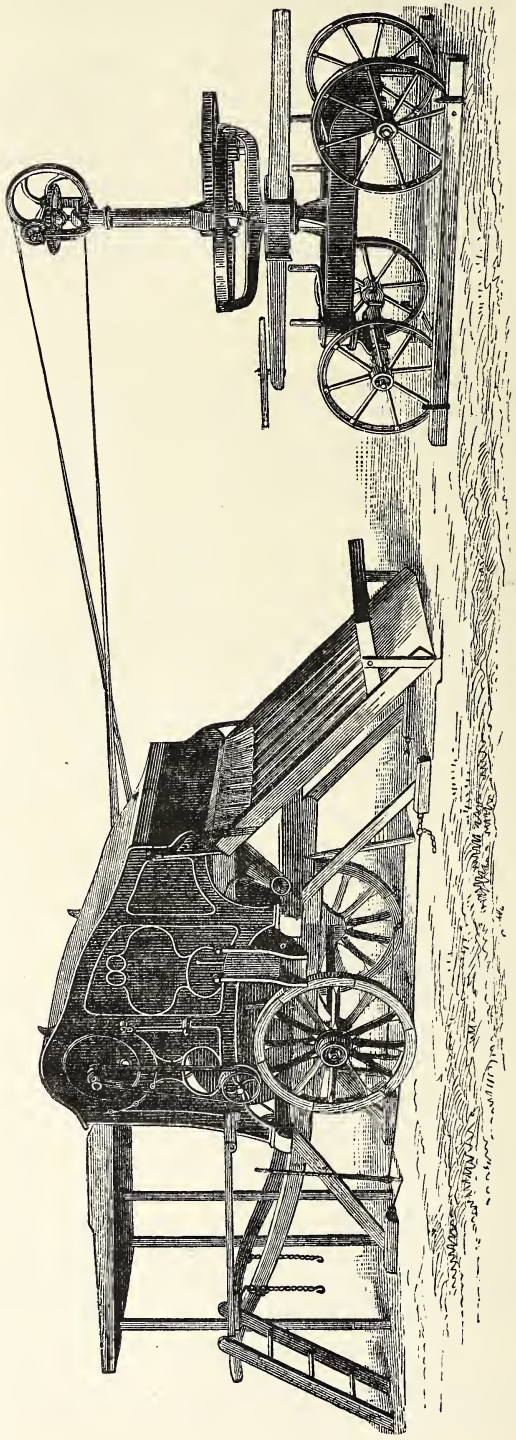
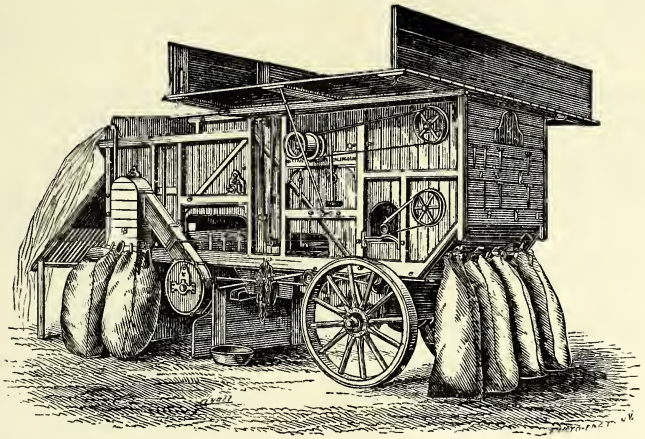


FIG. 176.—*French portable thrasher and mounted horse-power. T. Gautreau, Dourdan, France.*

having been present, and spoke of the American machine in the highest terms. *Thrashing machines.*

A gang of men stands on top to handle the sheaves, untie the bands, and feed the grain. So customary is this method, which seems clumsy and unhandy to us, and so dangerous is it, that the manufacturers are now all compelled by act of Parliament to provide a drum-guard to prevent men from falling into the mouth of the machine. Mode of feeding the British machines. Drum-guard.



Large thrashing machine, Ruston, Proctor, & Co.

FIG. 177.—*First-class thrasher. Ruston, Proctor, & Co., Lincoln, England.*

The trial of thrashing machines took place at the *Esplanade des Invalides*, on August 5. We gained no laurels on this occasion. Our machines were not managed by parties familiar to the work, and the general statement made above as to the prejudice against the spiked drum met us here. The jury was principally French, and, of course, acted upon its judgment of European requirements in such machines. Ours did not suit the country, though there are places in Europe where they might be successfully introduced; not at present among French or English farmers. Thrashing machine trials at the Esplanade des Invalides.

Circumstances being as they are, it would be unprofitable to go into any detailed description of the interior of the machines, and it would not be advisable to occupy room in illustrating our own machines in a report addressed to our own people.

Our exhibitors were Case, of Racine, Wisconsin, Farquhar of York, Pa., and Taylor, of Westminster, Md. Our exhibitors.

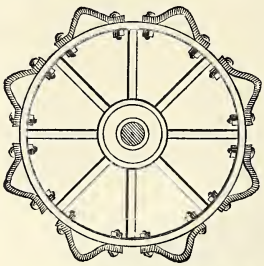
There are some special features of the English thrashers which are worth a notice.

Gérard, of Vierzon (*Cher*), has introduced a style of beater with oblique open slots, which is claimed to give an excellent result both in respect of conservation of the integrity Gérard's oblique beater.

Thrashing machines.

of the straw and the cleanness of the removal of the grain, without breaking the kernel. The direction of the oblique slots is alternating on the successive beaters, and the drum is a compromise between teeth and smooth beaters. It appears to have merit as such.

Laird's oblique slotted beater.



An apparatus has been applied for cutting the bands of sheaves and feeding them thus loosed into the throat of the machine by mechanical means.

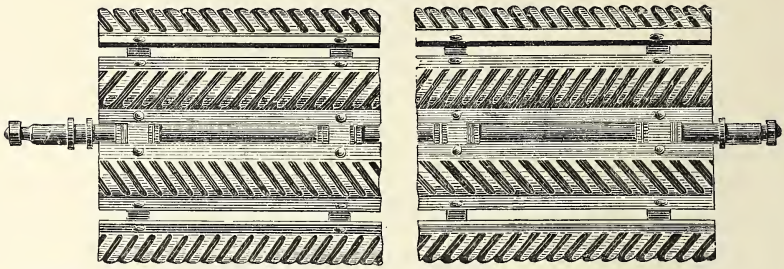


FIG. 178.—*Oblique-slotted beater for thrashers. Gérard & Fils, Vierzon, France.*

Band-cutters, self-feeders.

For cutting the bands three revolving steel disks with serrated edges are fixed in a convenient position under the

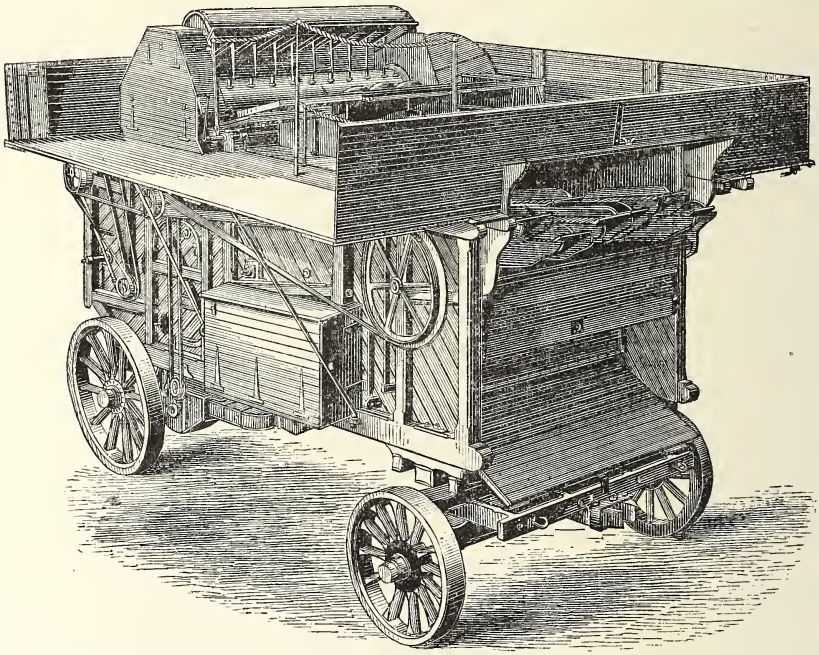


FIG. 179.—*Band-cutting and self-feeding apparatus. Marshall, Sons, & Co., Gainsborough, England.*

feed-board and project through it; these run in opposite directions, and overlap each other. The feed-board is constructed in two parts, the upper portion being fixed on a hinge, with suitable springs between it and the lower board. The attendant picks up the sheaves with an ordinary fork or by hand, and drops them on the lower edge of the upper board; the weight of the sheaf compresses the spiral springs, and so allows the band of the sheaf to come in contact with the projecting revolving disks; these cut the band, and allow the sheaf to fall forward on to the lower board, where it is carried on to the feeder by means of revolving prongs.

Thrashing machines.

Marshall, Sons & Co.

Band-cutter.

(Figure 179.)

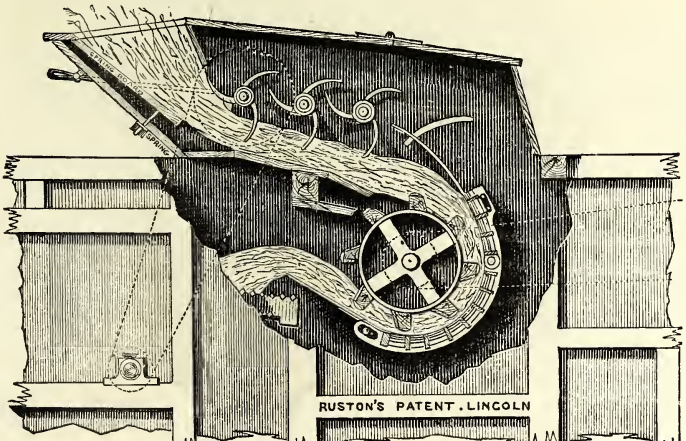
When the feeder is required to work on loose grain that is not bound in sheaves, the belt driving the disk-spindles is taken off, and the upper board is fixed in its highest position by means of a handle and screw, and thus becomes a rigid platform for the grain to pass over.

The mechanical feeder consists of a revolving barrel fitted with spikes, arranged in proximity to the lower feed-board. As the loosened sheaves fall on this board they are carried forward to the revolving roller by means of a series of revolving prongs, which deliver the grain within reach of the spikes. It is then carried along towards a line of oscillating forks, which spread it out evenly in its passage to the thrashing-drum. These oscillating forks are readily adjustable to suit varying descriptions of grain.

Mechanical feeder.

Price of the attachment, with band-cutter complete, £25. Price, without band-cutter, £20.

Price.



Automatic feeder. Ruston, Proctor & Co.

FIG. 180.—*Automatic feeder. Ruston, Proctor, & Co., Lincoln, England.*

The automatic feeder of Ruston, Proctor, & Co., of Lincoln, England, is shown in Fig. 180. Like that before men-

Thrashing machines. tioned, it is designed to replace mechanically the hand operation of feeding the grain to the machine.

Automatic feeder. It is placed transversely above the machine, and immediately above the drum; the wooden cover has an opening

Ruston, Proctor & Co. which forms a hopper for the entrance of the straw. The apparatus consists principally of a number of parallel shafts with backwardly-curved spikes, which engage with each other without coming in contact. The first spiked shaft catches the straw and passes it to the next, and so on from one to another till it arrives at the drum.

(Figure 180.) The spikes of the last shaft work between a series of stripping teeth, which prevent the straw from being carried back.

The safety apparatus consists of a spring-board, which forms the bottom of the hopper, and yields to any unusual weight, so that if a person or any other heavy object tumbles into the machine the yielding of the board draws upon a rod and disengages the driving-pulley. The same effect is produced by putting in an unbound sheaf, as the spikes of the first roller press it down upon the yielding board, the object being too large to pass the throat.

Fig. 181 is a plan view of the apparatus.

Plan view of automatic feeder.

Ruston, Proctor & Co.

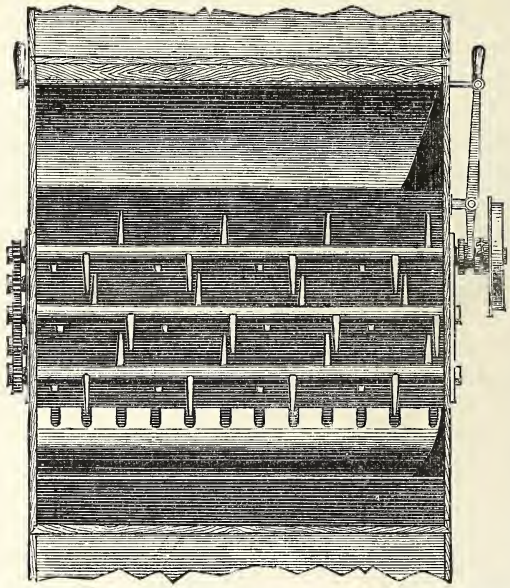
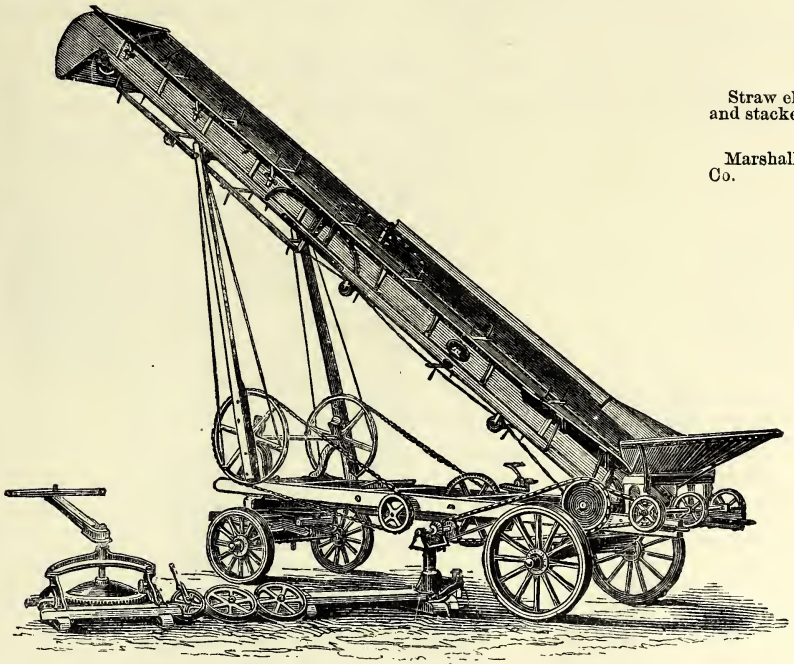


FIG. 181.—*Plan of safety-feeder. Ruston, Proctor, & Co., Lincoln, England.*

Straw-elevators. Straw-elevators, or stackers, act upon a similar principle to the American, but, instead of being mounted upon the tail end of the machine, and taking the straw from the straw-carrier direct (much the simpler plan), the European

straw-stacker is mounted on its own running-gears, and has a hopper to catch the falling straw, and a traveling endless

Thrashing machines.



Straw elevator and stacker.

Marshall, Sons Co.

FIG. 182.—*Straw-stacker, rigged for use. Marshall, Sons, & Co., Gainsborough, England.*

spiked carrier, which elevates the straw and drops it upon the rick.

Straw-stacker, folded.

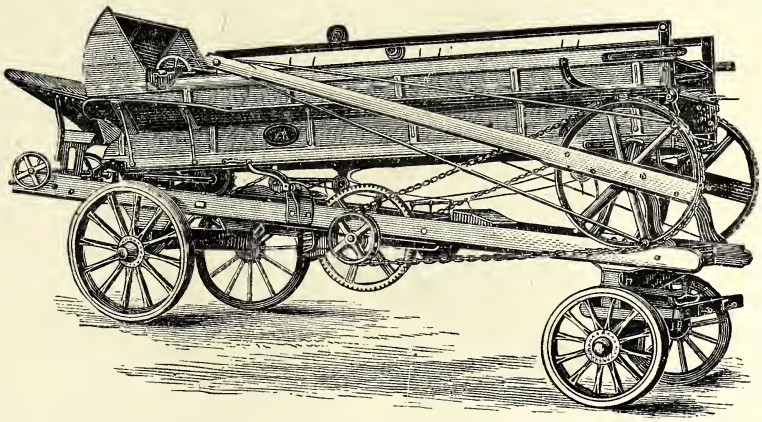


FIG. 183.—*Straw-stacker, folded. Marshall, Sons, & Co., Gainsborough, England.*

The one shown in the illustration is made by Marshall, Sons, & Co., of Gainsborough, England, and is in two hinged sections, the lower one of which is hinged to the wagon and the upper one to the lower portion. For traveling or

Thrashing machines.

storage, the upper one folds over and rests flat upon the lower section, the latter lying horizontally upon the wagon.

Straw-stacker.

Marshall, Sons & Co.

The illustrations show it as rigged for use, and folded, respectively; the degree of elevation is according to the required height of the stack. A special horse-power may be used to run the straw-elevator, and is shown alongside of it.

(Figures 182,183.)

English thrasher at work.

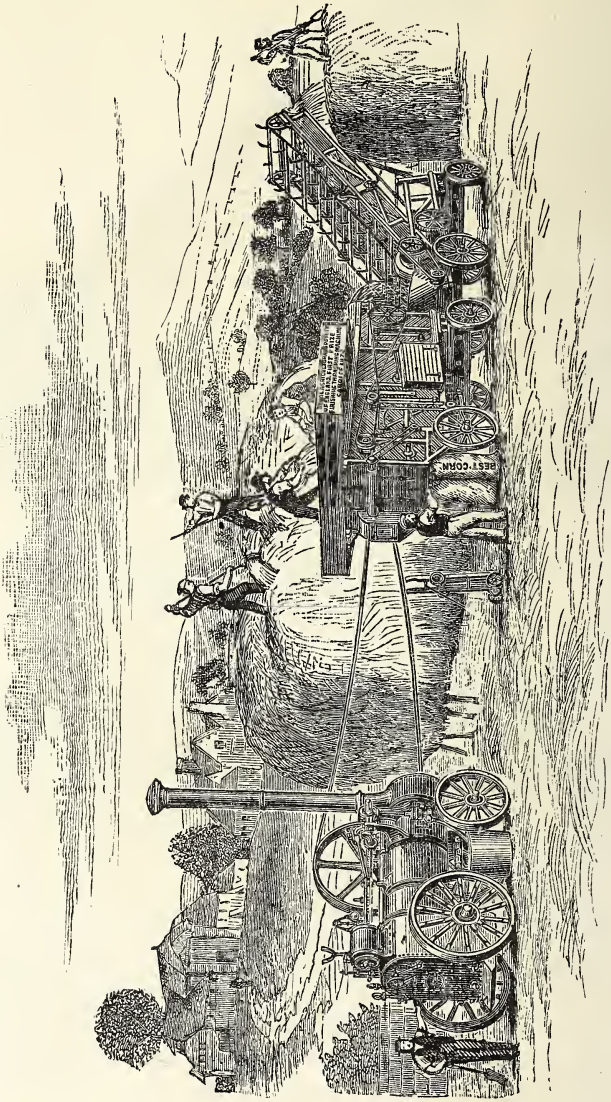


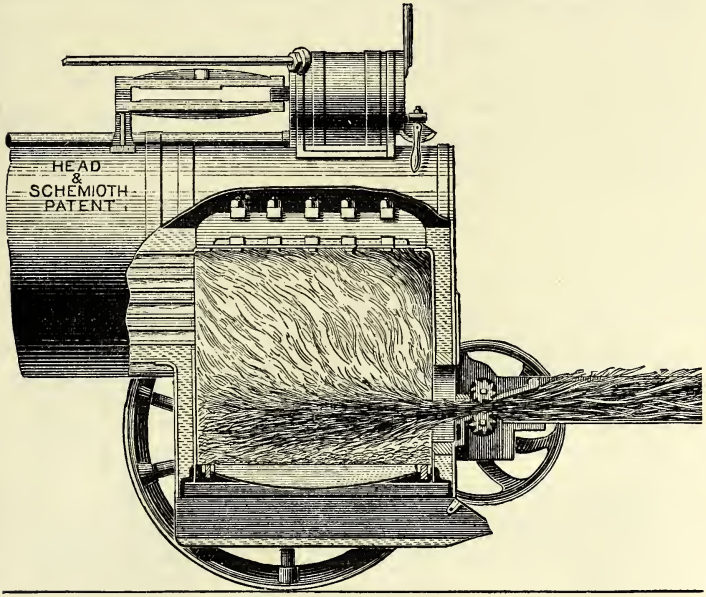
FIG. 184.—*Complete English thrashing apparatus.*

Straw-stacker. (Figure 183.)

When folded, Fig. 183, the highest part is not over 8′ high, and it may be run into any ordinary shed. Its capacity for elevation is from 25′ to 28′ for the different sizes, and the prices are £45 and £48, respectively. It will deliver at any

angle within a certain range of adjustment. It may be driven from the thrasher, and is so ordinarily; the special

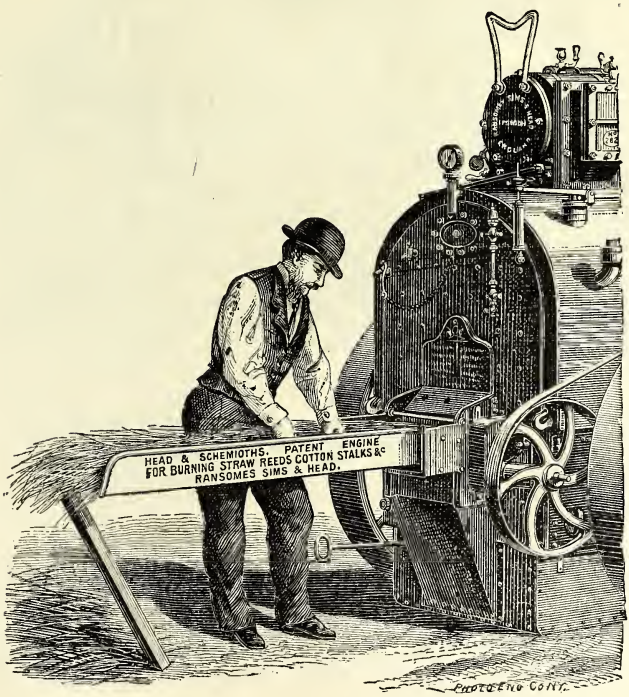
Thrashing machines.



Straw-burning engine.

Ransomes, Sims & Head.

FIG. 185.—*Section of straw-burning engine furnace. Ransomes, Sims, & Head, Ipswich, England.*



Straw-burning engine.

FIG. 186.—*Straw-burning engine. Ransomes, Sims, & Head, Ipswich, England.*

Thrashing machines. horse-power being designed to drive it when using it for elevating sheaves or hay for stacking.

Horse-power, with hauling-wheels, £7 17*s.* 6*d.*

Horse-power, without hauling-wheels, £7.

Ransomes, Sims & Head's straw-burning engine. Ransomes, Sims, & Head, of Ipswich, England, have an agricultural engine (Figs. 185, 186) adapted to burn straw, cotton and corn stalks, reeds, sugar-cane refuse, or sedge grass (as well as coal or wood).

(Figures 185, 186.)

Agricultural straw - burning portable engine.

Ruston, Proctor & Co.

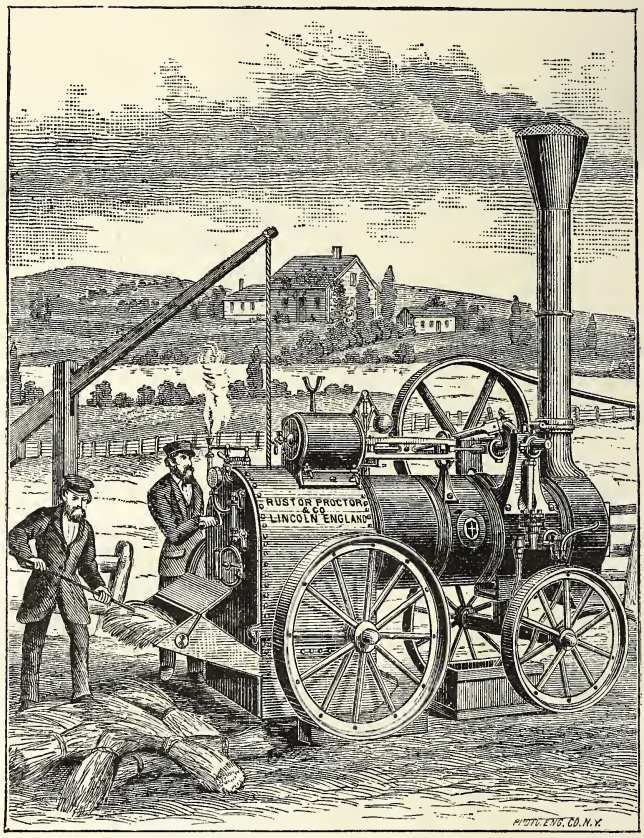


FIG. 187.—*Straw-fed portable engine. Ruston, Proctor, & Co., Lincoln, England.*

Ransome's straw- burning engine. There are many parts of the United States where fuel of this kind is abundant in the field, and where ordinary fuel is distant or expensive.

(Figures 185, 186.) The apparatus for feeding the engine with straw is self-acting and driven from the engine by means of a strap. It can easily be disconnected from the boiler and the ordinary fire-door substituted in its place in cases where it may be expedient to burn wood or coal.

Thrashing machines.

Steam may be gotten up with straw as easily as with any other combustible by attaching a handle to the feeding-rollers and turning them by hand instead of steam power. One man only, it is stated, is necessary to feed the straw into the machine.

Ransomes, Sims, & Head's engine. (Figures 185, 186.)

The average consumption of straw is about four or five times the weight of that of coal, and, according to experiments made, about 8 or 10 sheaves of straw are required to thrash 100 sheaves of wheat.

A number of these engines have been at work in Russia and other countries burning straw; they have also been used in Egypt with cotton stalks and in India with indigo refuse as fuel.

Straw-burning engine. (Figure 187.)

Other machines, such as that of Ruston, Proctor, & Co., operate simply by stoking, having no automatic feed. Such is shown in Fig. 187.

Clover-huller.

Hullers for clover, lucern, sainfoin, *minette*, and similar seeds are made with single or double cleaners, the latter putting the seed and chaff a second time under the influence of the blast.

Brouhot & Co.

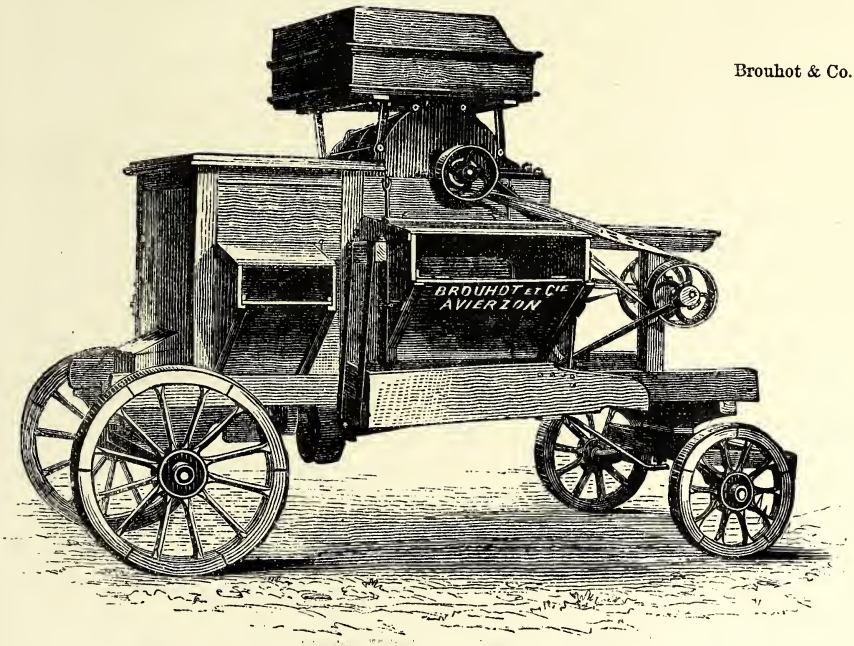


FIG. 188.—*Huller for clover, lucern, and sainfoin seed. Brouhot & Co., Vierson, France.*

The machine has two beating-drums, brought into very careful and adjustable apposition, which rub the seed-head effectively between the intimately associated surfaces. The

Thrashing machines. cleaning is done by two fans, which act successively on the grain while it passes over a series of shaking-riddles.

Clover-huller. The machine is driven by a 4-horse-power engine.

Agricultural engines.

AGRICULTURAL ENGINES.

These were considered in the class which included steam-engines (Class 54) and not by the jury in agriculture.

Some of the portable engines, however, are described under "Steam Culture," pages 66–79. Many of the engines adapted to steam plowing may be utilized at other times for the purposes of thrashing, pumping, sawing, etc.

GRAIN-CLEANERS. *Grain-cleaners.*

The French have an excellent line of machines for winnowing, screening, and sorting grain and seeds, and have a great need of them, for several reasons.

French need of separating- machines.

They frequently sow and harvest two crops together, such as oats and vetches (tares) for instance, and then sort the thrashed results.

Weeds of field crops.

The crops seem to be more harassed by weeds; the common red poppy, the wild vetch, and cockle seem to be ineradicable from the wheat. A weed known as *crescute* is is also a great pest in the clover, as it ripens at the same time and the seed is so nearly of the same size and gravity. It is perhaps rather a local nuisance, as the complaints of it were only occasionally heard, like the wild onion of Virginia, which, like the *crescute*, requires specially constructed machines to remove it.

Mode of harvesting.

The methods of harvesting are somewhat slovenly. The crops cut with the sickle, cradle, or scythe lie upon the ground to cure, and the result is that stones and clods of dirt are very numerous in the thrashed grain. Even the mode of thrashing increases the quantity of this foreign matter, for it is largely done in installments on the soil floor of barns and sheds.

Peculiar principles of French machines.

In the French machines are many peculiarities; while some of the machines act upon principles and by methods familiar to us, others employ methods very diverse from ours.

Names of machines.

Their names are as various as their kinds, and suggest, with truthfulness, a greater diversity of operation and construction than is to be found in this class of machines in the United States.

The names indicate the construction or purpose, as—

French indicative names.

Tarare	Blast-fanning-mill.
Aspirateur	Suction-draft fan-mill.
Nettoyeur	Cleaner.
Cribleur	Sifter.
Trieur	Sorter.
Épierreur	Stone-remover.
Émotteur	Clod-remover.
Diviseur	Separator.

Then, again, a whole line of machines is to be found in the extremely interesting series made by Hignette, of Paris,

Grain-cleaners. specific machines for operating in certain ways, upon certain grains, or combining certain principles of action.

Combined machines by Hignette. The combined machines bear the following names, which are descriptive:

Épierreur-trieur.	*Cribleur-aspirateur.*
Cribleur-épierreur.	*Tarare-aspirateur.*
Cribleur-aspirateur-trieur.	*Cribleur-trieur-diviseur.*

These may be readily understood by collocation with the terms above.

Classification. To summarize, the machines may be described as acting by—

Blast.	Adjustable cylindrical sieve.
Aspiration.	Perforated and dented plates.
Graduated sieve.	Percussion.

These distinctions cannot be strictly maintained in the arrangement of the examples following, as several of the special contrivances enumerated are sometimes found in the same machine.

Machines used in connection with a run of stones. Another class of machines consists of cleaners used in connection with grinding mills, for cleaning the grain by an apparatus placed between the wheat-hopper and the run of stones. Several machines of this character were shown, and in three cases were associated with devices for damping the grain, to assist in the operation of removing the bran.

French exhibitors in the latter class. The French exhibitors of this special feature were—

Adolphe Vève, Avignon (*Vaucluse*).

Rose Frères, Poissy.

Rebel, Moissac (*Tarn-et-Garonne*).

These machines, however, bring us within the class of milling (Class 52), and, as such, are outside of the class (76) considered in this report.

Blast and aspirator machines.

Blast and aspirator machines.

In winnowing machines, or fanning mills, the type prevailing in the United States is quite common in France, but in addition to these is an excellent form of machine which works by *aspiration* instead of *blast* (*tarare-aspirateur*).

Aspirating winnower. One form of this is shown in Fig. 189, a machine exhibited by Girardin, of Étampes, France.

(Figure 189.) The parts indicated by letter in the cut are as follows:

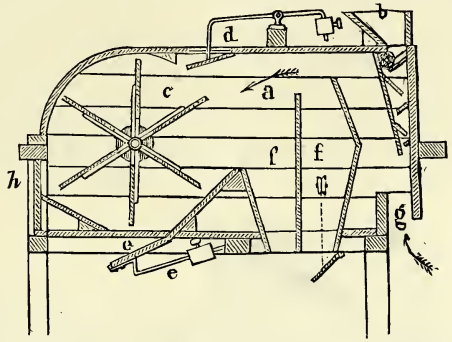
Girardin.

b, wheat-hopper.	*a*, air-passage.
g, discharge of clean wheat.	*f f'*, first and second tailings.
c, aspirating-fan.	*e*, third tailings.
d, air-regulating valve.	*e'*, valve-regulator.
h, exit of dust and chaff.	

The prices are from 200 to 350 fr., according to size; intended for cleaning from 300 to 1,600 kilos (say 10 to 60

bushels) per hour, at a driving speed of 350 turns per minute of the fan-shaft. *Grain-cleaners.*

Another form of the same machine has an additional apparatus above for sifting out larger trash and clods of dirt.



Aspirating winnower.

Girardin.

FIG. 189.—*Aspirating winnower. A. Girardin, Étampes, France.*

It is a long shaking-riddle, over which the uncleaned grain traverses before reaching the wheat-hopper *b*.

The grain passing down the zigzag from the hopper is scattered by the impediments in its track, and, issuing from the spout, is met by the upward blast of air, which only allows the heavier grain to pass in defiance of the air out at the spout *g*. Description.

The next grade in weight tumbles over the edge of the first divisional board into compartment *f*, and a third grade is carried by the air-current over the second divisional into compartment *f'*. The third grain, consisting of light seeds and white caps, reaches *e*, while the lightest of all, chaff and dust, do not fall, but pass out with the air-current at *h*. The regularity of the air-blast is obtained by the balanced valve *d*, which opens wider when the speed is increased.

The machine has a great deal of merit, and has some resemblance, in parts, to our aspirating smut machines as used in mills, but is a useful adaptation of the aspirating fanning mill to the uses of the farm.

Graduated sieve.

Graduated sieves.

A British form of machine for cleaning grain at a single operation, and made by Boby, of Bury St. Edmunds, England, is shown in Fig. 190.

The machine has a wooden frame and a long inclined sieve, which receives at its upper end the grain from a hopper. The grain issues in a thin sheet from the hopper, and first falls upon a separator, which arrests stones and large trash, allowing the grain to pass down and be discharged in a sheet

Boby's English grain-cleaner.

(Figure 190.)

Grain-cleaners. as wide as the inclined sieve beneath. This sieve receives a longitudinal agitation by means of a pitman from a crank on the horizontal axis, which is revolved by hand-crank or belt, as the case may be.

Boby's English The longitudinal wires of the shaking sieve are carefully stretched and are spaced so as to retain plump grains and allow broken or thin grains to pass, and the meshes are kept open by thin blades, which also rectify the positions of the passing grains and bring them into parallelism with the wires along which they pass in their descent from the stone-separator to their point of ultimate discharge.

grain cleaner and separator

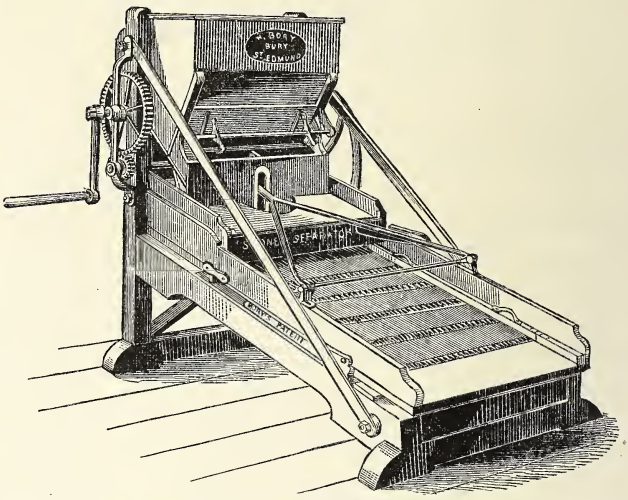


FIG. 190.—*Grain cleaner and separator. Robert Boby, Bury St. Edmunds, England.*

for sorting barley. The machine is particularly intended for the cleaning and sorting of barley for malting, and the necessity of a perfect action in this respect is set forth in the statement following:

Necessary conditions of an effective barley-sorting machine. 1. It is essential that, in advance of the payment of the impost duty [internal revenue or excise tax] on the steeped malt, the entire mass must be rid of matters which produce deficient quantities of saccharine extract.

2. It is necessary to separate all light grains before making the malt, for otherwise they will become too damp or saturated in the time necessary for the sufficient steeping of the good grain.

3. The thin or light grains must be absolutely separated from the full-sized grains before making the malt, for otherwise the thin grains pass unbroken between the rollers in the process of crushing the plump grains.

The operating surface of the Boby sieve is stated to have six times the area of the usual rotary sieve, and, the grain

Grain-cleaners.

The Boby sieve. (Figure 190.)

being spread over so great a surface, each light grain is sifted out in passing from the hopper to the discharge; in the rotary sieve the acting surface is only at the lower side, estimated as only embracing, at any one time, one-ninth of the peripheral.

Adjustable cylindrical sieve.

Adjustable cylindrical sieve.

Another form of screen for grain was shown by several English and French exhibitors, the one selected for illustration being that made by Penney & Co., of Lincoln, England.

Penney & Co.

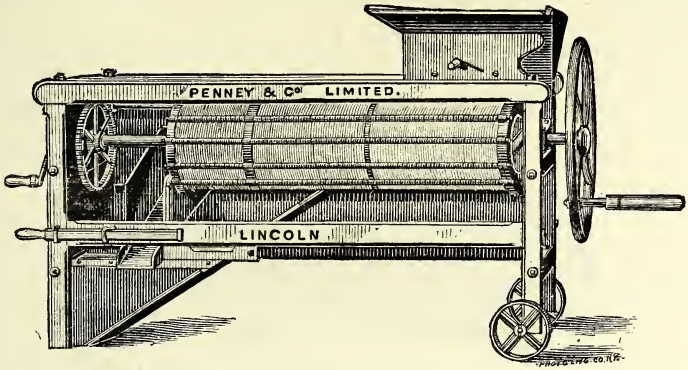


FIG. 191.—*Adjustable rotary screen (with stone-separator). Penney & Co., Lincoln, England.*

Purpose.

It is made of various sizes and prices, and there are also special constructions for certain purposes, such as the cleaning and grading of malt, the cleaning of pease and beans, etc. The latter-mentioned articles require such a very different range of adjustability that the machines cannot be economically made to suit the wide ranges of work.

The machine can be adapted for all species and qualities of grains (within profitable limits, as stated) by means of varying the distance between the wires.

Construction.

The cylindrical screen may be said to consist of one continuous wire spirally laid around the longitudinal bars which form the skeleton of the screen. One of the heads is adjustable longitudinally of the axis of rotation, slipping thereon, and, as it is drawn towards the extremity, the spaces between the laps of wire become larger, and, conversely, the intervals are diminished as the heads are approached by the reverse adjustment. Spiral springs, mounted upon the exterior rods as in Fig. 191 (*ressorts extérieurs*), or within the cylindrical screen as in Fig. 192 (*ressorts intérieurs*), keep the screen extended longitudinally.

Grain-cleaners. The different kinds of brushes used for cleaning the meshes of the screen are shown in Figs. 192 and 193.

Rotary screen with brush; exterior springs.

Penney & Co.

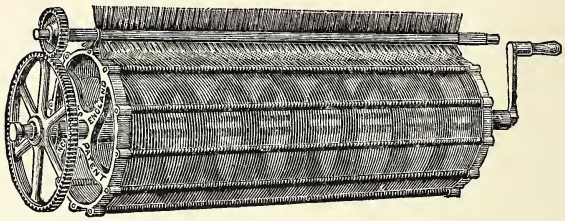


FIG. 192.—*Adjustable rotary screen (dismounted) (ressorts extérieurs). Penney & Co., Lincoln, England.*

Regularity of passage through the length of the screen is secured by a spiral flange or rib projecting inward from the cylindrical surface, which tumbles the grain along until

Rotary screen; interior springs.

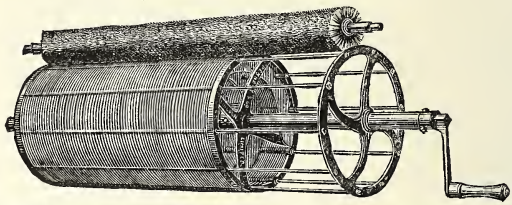


FIG. 193.—*Adjustable rotary screen (dismounted) (ressorts intérieurs). Penney & Co., Lincoln, England.*

it pushes it out at the end. Dry and broken grain is retarded, while damp grain is expedited in its passage, the rate being thus made uniform though the condition of the grain may vary.

Description of Penney & Co.'s adjustable rotary screen.

(Figure 191.)

The machine shown in Fig. 191 is composed of two parts, of which the second and lower has screen-openings of greater interval than the first part. It is intended for grain which contains stones, ordure of vermin, or other matters larger than the wheat or the grain to which the machine is for the time adjusted. The stones and other large matters pass clear through the screen and into a spout, which ejects them at the side; the good grain passes over the meshes of the first part of the cylinder and is divested of the small and broken grains which pass the meshes; it then itself falls between the meshes of the second portion of the cylinder, and is discharged by a spout at the end, while the stones pass on and so to the side spout as stated.

The prices below are for machines of this description: *Grain-cleaners.*

Prices of Penney & Co.'s adjustable rotary screen.

(Figure 191.)

Number.	Diameter of the screen, with exterior springs.	Length of screen at greatest extension.	Price in London.	Price in Paris.
	Millimeters.	*Meters.*	£ s. d.	*Francs.*
1	406	1.448	14 0 0	*400.00
2	406	1.752	16 0 0	*450.00
3	508	1.448	17 10 0	*487.50
4	508	1.752	20 10 0	*562.50
5	406	1.524	15 10 0	†437.50
6	406	1.905	18 0 0	†500.00
7	508	1.524	18 15 0	†518.75
8	508	1.905	22 0 0	†600.00
9	762	1.752	33 0 0	‡925.00
10	762	2.133	38 0 0	‡1,050.00

* Nos. 1, 2, 3, 4 have the two parts adjusted at one extremity.
† Nos. 5, 6, 7, 8 have adjustments at the respective extremities.
‡ Nos. 9, 10 are made at buyer's option, either way.

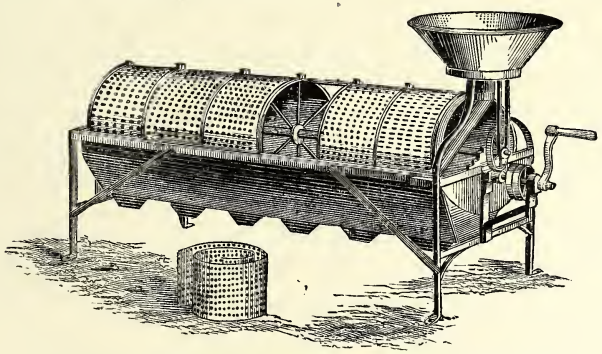
Packing extra. Machine for working by hand-crank.

Perforated and dented plates.

Perforated and dented plates.

The riddle-sorter of Pernollet, Paris, was shown in several forms, some adapted for the ordinary uses of the farm in cleaning grain, and others for special service, such as cleaning green pease, young beans, lentils, coffee, cacao, for sorting different kinds of barley for brewers.

The machines, in some cases, are specially constructed for a given purpose, but in others the change of the perforated iron plates for others of larger or smaller apertures is sufficient to adapt the machine to the required purpose. Riddle-sorter.



Pernollet.

FIG. 194.—*Riddle-sorter. J. Pernollet, Paris, France.*

The grain is placed in the hopper, its rate of feed depending upon the slide in the bottom. An oblique spout conducts the grain fairly within the rotating cylinder, whose four compartments, being clothed with punched iron screens of different apertures, sort the different kinds and drop Description

Grain-cleaners. them into boxes beneath. The respective screens have round holes of different sizes, or long holes, to detain or to allow to pass, as the case may be, seeds of varying sizes and shapes.

Pernollet's riddle-sorter.

The prices and capacities of the machines are, according to size and the number of compartments:

Prices and capacities.

	Cylinder, diameter.	Length of cylinder.	Weight.	Work per day.	Price.
	Centimeters.	*Meters.*	*Kilos.*	*Hectoliters.*	*Francs.*
Small size	55	1.25	40	35	110
Larger size	65	1.75	70	60	220

The above have invariably four compartments. Larger machines, having from five to eight compartments, with a variety of changeable plates, sell at from 385 to 1,100 fr.

Machines with indented plates.

Another class of machines, of which there were several excellent examples, introduces an entirely new feature into grain-cleaners, namely, "indented plates," which form pockets to carry up seeds on the inside of the cylinder and drop them into a tray, which carries away the seed thus segregrated from the other contents of the rolling cylinder.

The "indented plates" are sectional cylindrical jackets, like the perforated covering of the Pernollet machine just shown, but instead of holes they have pockets or cups, made by punching or drilling. Specimens in each method were shown, but those indented by a blow were preferred.

As in the case of the Pernollet machine and others of its class, the enveloping cylinder had perforations in its four sections of varying sized apertures, according to the special work to which it has to be applied; so in the case of the

Marot's

Marot machine, the indented jacket, with its recesses facing inward, has pockets of such size and shape as to catch and hold special kinds of grain or of seeds which it may be required to abstract from the mixed or foul material fed into the machine.

double-action grain-sorter.

The double-action grain-sorter of Marot, for removing from the wheat not only round grains of all sizes, but also the barley and the oats, has been familiar to the French agricultural public since 1858.

Former prizes.

In 1860 it obtained the gold medal at the Concours Général at Paris; in 1867 the first prize at the Paris Exposition and at Billancourt; and more than 60 first prizes in the provincial exhibitions which followed.

However effective the machine might be for eliminating from the wheat casual grains of other kinds, it still remained

impossible to separate the *méteils* (mixture of wheat and rye) or the mixed barley and oats. *Grain-cleaners.*

Marot's grain-sorter.

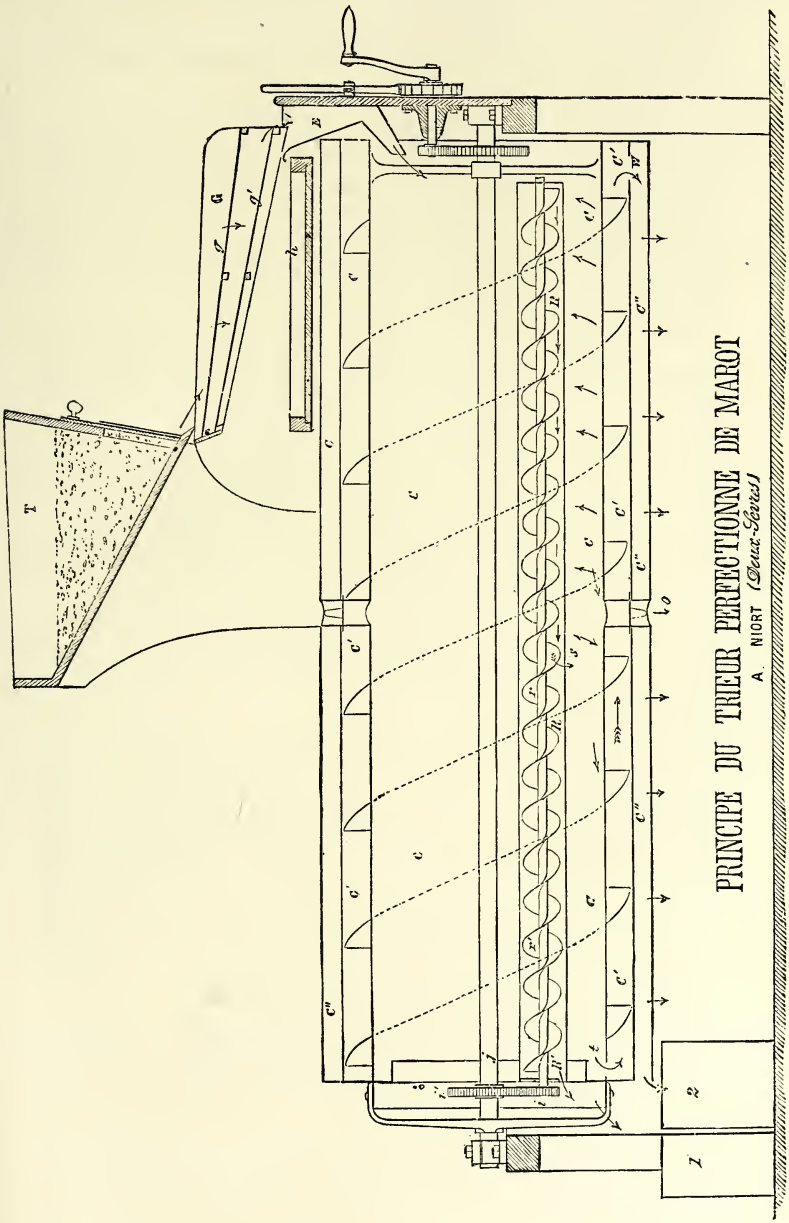


FIG. 195.—*Marot's grain-sorter (trieur). J. Marot Aîné, Niort, France.*

The new Marot "grain-sorter," Figure 195, while preserving its previous qualifications, effects the last two operations most effectively by means of indented perforated plates forming cylinders around the axis of rotation.

Grain-cleaners.

Marot's grain-sorter.

The new mode of screening compels the long grains to pass through round holes equal in size to their diameter, a result vainly sought until now, and which can be readily understood in looking at the perforated cell, the entrance to which is three times as large as the perforation, being in fact funnel-shaped.

It will be well to enter into a detailed statement of the functions of the different parts for the better understanding of the process and operation and the perfection attained.

Description.

The grain-sorter is composed of a dented cylinder inclosed in a wooden frame, which is surmounted by a hopper, T, and in prolongation thereof is a double inclined riddle, agitated by connection with a wheel.

The upper riddle, *g*, retains all the impurities and large round grains; the lower riddle, *g'*, allows passage to the rye-grass seed, small seeds, and refuse, which fall into a tray, *h*, placed athwart the frame.

The wheat falls off the end of the riddle into a hopper, E, and thence into a spout, which conducts it into the interior of the cylinder C. In a central position in the cylinder beneath the axis *j* is a trough, R, in which is a conveyor, *r*, rotated by a pinion, *i*, from a wheel, *i'*, on the axis *j*.

The first part of the cylinder C is studded with indentations (concave interiorly, but not perforated), as shown in Fig. 196, which is a portion of one of the plates.

Dented plates.

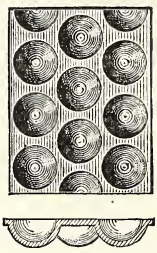


FIG. 196.—*Dented plate (as used in cylinder C).*

These depressions are of such diameter that the wheat and round grains may lodge in them, and in the movement of the cylinder their contents are lifted and dropped into the trough R, while the barley and oats are prevented, by their length, from lodging in the cups, and, following the slope of the cylinder, are discharged at the opening *o*, at its mid-length.

Mode of operation.

The wheat and round grains, carried up the cups and caught in the trough R, are carried along by the conveyor *r*, and fall into the cylinder through an opening, *s*, at a point beyond the discharge, *o*, of the oats and barley. Here they come under the action of the second part of the cylinder, the inner surface of which has depressions of smaller diameter, suitable for carrying up the round grains, such as tares, but rejecting the wheat. The tares, etc., are dropped into the trough R', which is a continuation of R, and, being pushed by the conveyor, are forced out at the end and led by a spout (not shown) into the box 1.

Grain-cleaners.

Marot's grain-sorter.

The wheat, deprived of oats, barley, and round grains (tares, mustard, rape, etc.), follows the slope of the cylinder to the point *t*, where it falls into the cylinder C′. It passes backward along the whole length of the cylinder, pushed by the helicoidal wings which form a conveyor on the periphery of cylinder C.

Mode of operation.

At the point *w*, beneath the place of first entry into the cylinder, the wheat, with some other grains not yet eliminated, falls into cylinder C″, which consists of plates both dented and perforated, concavity inward. The grain is caught in the cups and carried up, and, while the diameter of the holes is not sufficient to allow good wheat to pass, the shrunken grains, cheat, rye, rye-grass seed, etc., pass through the openings indicated by the lower row of vertical arrows, and fall upon the floor, while the clean wheat is discharged at the end into box 2.

Dented and perforated plates.

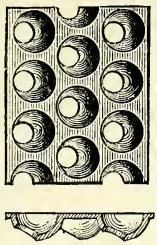


FIG. 197. *Dented and perforated plate. (As used in cylinder C″).*

Sizes and prices.

The sizes and prices of the machines are as follows:

Numbers.	Length.	Width.	Work per hour.	Price.
	Meters.	*Meters.*	*Hectoliters.*	*Francs.*
1	2.40	0.68	1.5	350
2	1.85	0.68	1.5	300

Larger machines for millers are from 350 to 1,000 fr., cleaning up to 6 hectoliters (16 bushels) per hour.

Another machine is especially constructed for the separation of *crescute* from clover or lucern seed.

Barley-sorter.

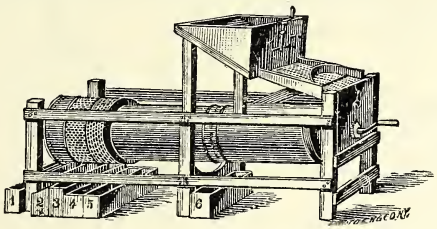


FIG. 198.—*Barley-sorter for breweries. J. Marot Aîné, Niort, France.*

J. Marot.

The machine for the special use of maltsters and brewers has substantially the same features in the main, but, in addition, it has three circular riddles at the delivery end of the machine, to separate the barley into three grades according to the diameter of the grains.

The object of the separation is to secure an even germination, as it is found that the different development or con-

Grain-cleaners.

dition of the grain causes the sprouting to be more or less rapid; and, consequently, to mix different grades of barley is to obtain an uneven quality of malt, as the plumules and radicles are unevenly developed, indicative of different stages in the fermentation of the components of the grain.

Marot's barley-sorter.

Price.

The price of a machine of this class. to clean 27 bushels per hour, is 1,050 fr.

Mixed grains sown in France.

The mixing of various kinds of grain, which we try to avoid, is taken as a matter of course in some of the circulars of the machine-makers in France.

In the published description of the sifting-sorting-separator (*cribleur-trieur-diviseur*) of M. Caramija-Maugé, of Paris, the following occurs:

Machines for sorting the yield.

"I have added to my machines all the indispensable improvements for the perfect cleaning of wheat, barley, rye, and oats, seing that these different grains naturally grow together (*mélanges entre eux*) and that they also contained a larger or smaller quantity of other long or round seeds [pease, vetches, cockle, cheat, etc.]"

The machine-maker has, therefore, addressed himself to the ordinary condition of things, as he seems to express it.

The Caramija-Maugé machine is shown in Fig. 199.

Sifting-sorting-separator.

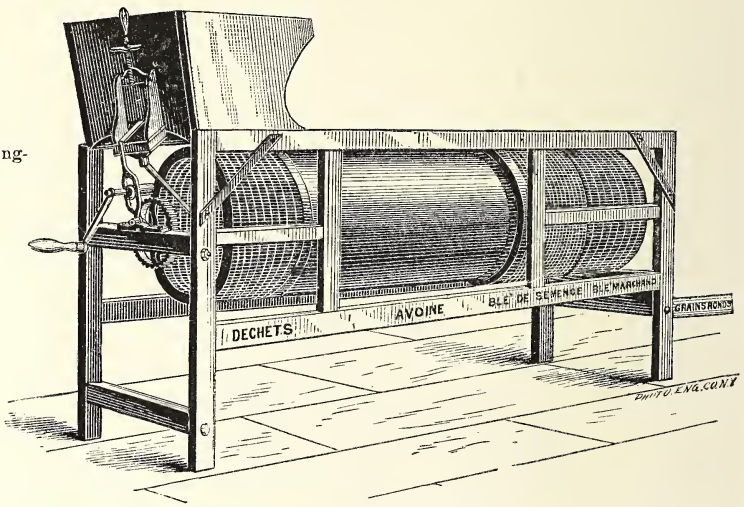


FIG. 199.—*Sifting-sorting-separator. L. E. Caramija-Maugé, Paris, France.*

Caramija-Maugé.

It acts in the same general way as that of Marot, previously described, but carries the principle of separation to a fuller extent.

Description.

The grain in the hopper on the left passes through a gate and by a tube to the interior of the rolling-screen. The first section removes small seeds and waste (*déchets*), and then the dents in the first portion of the cylinder raise the wheat and round grains and drop them into the interior

Grain-cleaners.

Sifting-sorting machine.

tray, where the spiral blade drives them toward the second section of the cylinder. The long grains, oats and barley, are pushed along in the first section of the cylinder until they reach the exterior holes, at which they issue.

Caramija-Maugé.

The wheat and round grains being conducted into the second section of the cylinder, as stated above, the round grains are picked up by the dented surface and raised so as to drop into the second interior trough, wherein a spiral works to thrust them out at the end, where they fall into the box shown at the right.

Description.

The second section of the cylinder has portions of differing fineness of mesh, sorting the wheat into qualities for seed and for market.

Sorting into five grades.

The result of the operation is five grades; reading from the left to the right, they are as follows: Waste, oats and barley, seed wheat, merchantable wheat, round grains.

Value of means for adjusting separately the cylindrical screens, etc.

One point is more particularly urged by the exhibitor in this case, as rendering his apparatus superior to others of generally similar construction, namely, that in other machines (such, for instance, as that of Marot, shown in longitudinal section in Fig. 195) the interior tray has but a single adjustment for height and slope, the inclination being equable from one end to the other. It is claimed for the Caramija-Maugé machine that the different character of the material in the first portion of the cylinder from that in the second requires different adjustments of the interior trays and conveyors. This the Caramija Maugé machine meets by making the regulations of the interior apparatus of the respective ends of the cylinder independent of each other.

Mode of operation.

The necessity for this arises from the fact that in the respective portions of the cylinder the interior depressions or pockets are of different sizes and have a different duty. Those in the first portion are larger in size, and have the duty of elevating the wheat and round grains, rejecting the long grains—oats and barley—which latter are ejected near the midlength of the cylinder, while the contents of the interior trough—wheat and round grains—are fed into the second part of the cylinder. This second portion has smaller dents or pockets, which serve to raise the round grains—vetches and pease—rejecting the wheat, the round grains being passed out at the end of the machine, while the wheat of two grades issues beneath.

Capacity of machine.

In the ordinary double-acting machine the length is 2.30 meters; width, 0.67 meter; height, 1 meter; quantity cleaned per hour, 200 kilos; turns of cylinder, 10 to 12 per minute; weight, 100 kilos; price, 160 fr.

Grain-cleaners.

PERCUSSION GRAIN-CLEANERS.

Percussion grain-cleaner.

Another form of machine, especially intended to remove stones and clods from grain, is shown in Fig. 200.

As many as six or eight different machines, all working on the same principle, were shown in the French Agricultural Annex, made by several manufacturers, but principally by J. Hignette, of Paris.

J. Hignette.

Percussion stone and clod clearer.

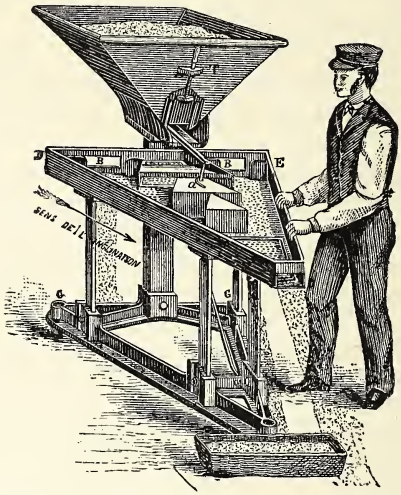


FIG. 200.—*Stone-clearer. Hignette, Paris, France.*

The tray has a rocking motion on its vibrating supporting bars, the crank making 115 turns per minute.

Mode of operation.

The grain, placed in the hopper, discharges at the lifted gate, runs over the slanting board and into the bed of the tray. It is divided to each side, and, as the tray is pushed laterally back and forth by a quick motion, the contents are sorted according to gravity.

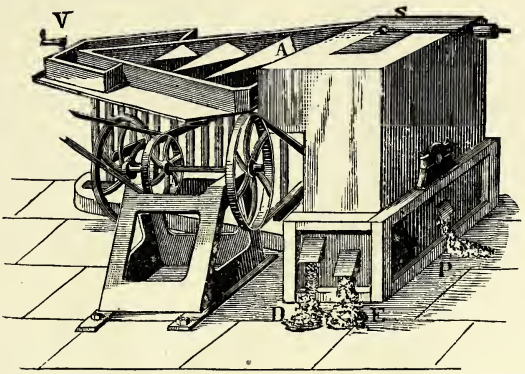
C C are adjusting-screws at the feet of the frame, so as to bring the tray to a normal level and distribute the grain equally to each side. The wheat issues at B, the stones pass out at O, the lowest point of the tray. The adjustment for inclination is at H. The stones, being heavier than the grains, resist the backward blow of the oblique faces of the central block, and pursue their way down the slope, while the grain passes out at B B.

Another application of the same principle is found in Fig. 201, where it is combined with an aspirator.

Aspirator and percussion stone-clearer.

The aspirator, working by poising, as it were, the grain, etc., in the air, sorts the material according to its gravity, the lighter imperfect grains and refuse being eliminated and

deposited in different receptacles, or discharging into the open air at different spouts. *Grain-cleaners.*



Aspirating and percussion stone-clearer. Hignette.

FIG. 201.—*Aspirating stone-clearer (Épierreur-aspirateur). Hignette, Paris, France.*

A statement of the matters thus eliminated from wheat or collected from the good grain (stones having been taken out in the vibrating stone-clearer, *épierreur*) shows the nature of the work performed:

Bad grain, spired grain (having a portion of the husk attached, known in England as white-caps), oats, rye, barley, brown rust, buckwheat, darnel (rye grass), straw, clods, ordure of mice, etc., weed seeds, and dust. Matters to be separated.

The machine is commended for cleaning wheat oats, rye, barley, colza, mustard, flaxseed, sunflower, rice, dried vegetables, hulled barley and grits, cacao, coffee. Applications of the machine.

A, entrance for foul grain.	E, heavy waste.
V, outlet for stones.	P, second waste.
D, wheat of second quality.	S, air-regulating valve.

The outlet for the best wheat does not show in the cut, being on the other side.

The proportion and price of a medium size machine are as follows: Size.

Length	meters	3.00
Width	do	3.00
Height	do	1.50
Turns of pulley per minute		100
Diameter of pulley	meter	0.40
Declivity, A to V	do	0.02
Quantity cleaned per hour	hectoliters	10
Price	francs	1,200

Capacity.

Price.

Another form of the machine has, in addition to the apparatus shown in Fig. 201, a rolling-screen such as shown in Pernollet's, Marot's, and Caramija-Maugé's.

The European judgment on straw-cutters is unanimous. While in the United States we have as many as five different principles, each of which seems to be maintained and to have its admirers, but one kind seems to be in any favor in Europe, that in which a curved knife on a wheel passes with a draw-cut transversely across the opening at which the straw is presented.

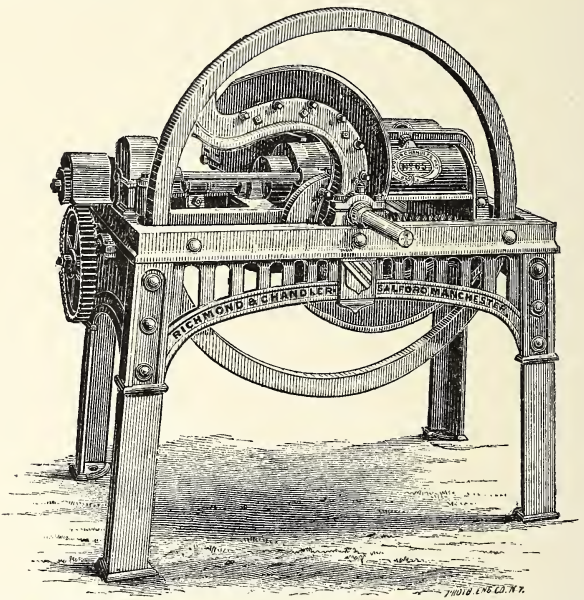
One principle principally used used in Europe.

It was the determination of the jury in this class to give no high commendation to any straw-cutter which was unprovided with the stopping and reversing motions conveniently placed, so as to be operatable by a man who might find his hand to be actually in danger.

Importance of the stopping and reversing motions.

The English straw-cutters were in great variety of sizes, one firm—Lowcock & Barr—showing 21 sizes, at prices from 52.50 fr. to 625 fr.

Variety of sizes of machines.



Straw-cutter.

FIG. 202.—*Straw-cutter. Richmond & Chandler, Salford, England.*

Fig. 202 is a machine exhibited by Richmond & Chandler, of Salford, near Manchester, England. It is furnished with a mechanism for arresting the feed either by means of the hand or the foot, and an automatic retrograde movement. The mouth has a width of $12\frac{3}{4}''$ and a height of $5\frac{1}{4}''$. An endless-chain feed is employed, which delivers to the pair of

Richmond & Chandler.

rollers. Price, with endless chain, £16 2*s*. This is but one of the sizes made by this firm. *Straw-cutters.*

Picksley, Sims & Co. Picksley, Sims & Co.'s. machine is mounted with a slipping-pinion for changing the length of cut without changing the wheels, and a mechanism for arresting the motion and reversing the feed. All the gearing is covered in with iron-caps and has bronze boxing.

Corbett & Peele. Corbett & Peele's machine makes the *stop* and *reverse* motion; the former by moving a handle within reach of the feeder, and the latter by moving the handle in the opposite direction.

Lowcock & Barr. Lowcock & Barr's machine has a lever so placed that a man who finds both his hands about to be or being drawn in can lean against the lever, which stops the motion and then instantly reverses it.

No American machines exhibited. There was much evenness of merit in the construction and working of the European chaff-cutters. We had none to compete with them. The interest, in view of the fact of honors being easy in the ordinary working parts, centered upon the safety arrangements.

Maize-cutter. The culture of maize is extending in Europe. In the Mediterranean countries it is already very large and very important. Several French and English firms put up the *grand hache-paille* or *hache-maïs*, specially for cutting corn-fodder. It has the same general construction as the ordinary straw-cutter.

Furze-cutter The *hache-ajonc*, or furze-cutter, is for cutting the prickly plant (*Ulex Europæus*), also known as *gorse* and *whin*, very common in Europe, and sometimes used as food for beasts. Being a woody spiny bush, it requires considerable strength in the machine, and the rollers are so arranged as to mash the plant before its presentation to the cutter. It is possible that in some of our less hospitable and mountain regions some plants may be utilized in the same way.

J. Crowley & Co. Edwards' safety-lever. The machines made by J. Crowley & Co., of Sheffield, England, have Edwards' patent safety-lever, which controls all the working parts of the machine concerned in the feed—the forward feed, stopping the feed, reversing the feed, and changing the length of cut.

The mouth is of steel and the feed-rollers of cast iron, the legs of malleable iron.

A traveling-web can be applied in the feed-trough, and this comes also under the control of the lever, to be stopped, started, reversed, or have its speed changed, as may be desired.

Straw-cutters.

J. Crowley & Co.

The machine is made of various sizes, for power or for hand.

Sizes and prices of machines with Edwards' safety-lever.

Sizes of mouth.	Price.	Revolutions per minute.	Chaff cut per hour.
	£ s. d.		*Pounds.*
8¼ by 2⅓ inches	2 7 6	.....	.....
9 by 3⅓ inches	4 0 0	.....	.....
10½ by 4½ inches	9 7 6	200	1,680
.....	21 10 0	200	6,720

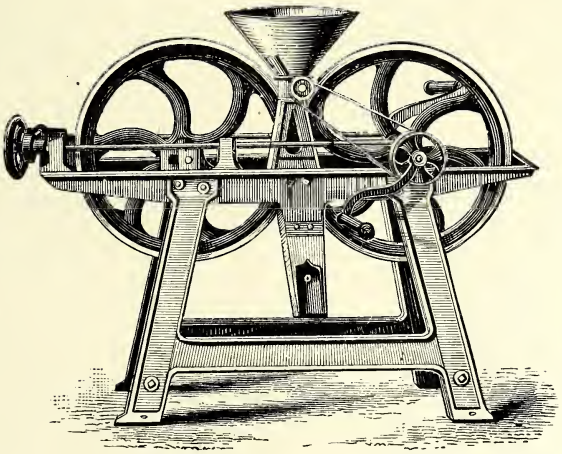
Calculated for a ⅜″ length of chaff. The larger sizes only have the safety and controlling lever. The last-mentioned size has the feeding-web and driving-pulley complete.

In England and in France there is a large demand for a class of small mills for rough-grinding grain for feed and for crushing oil-cake. These machines are known in England by several names—crushers, kibblers (French, *concasseurs*, *aplatisseurs*, *broyeurs*, etc.). The machines vary in their construction as in their effects, and pass by gradation into regular mills with buhrs. The product is intended simply for feed, and the breaking of the cuticle of the grain is substantially sufficient.

Great use of these machines in England and France.

The machine known in France as the *aplatisseur* was shown by a number of firms; Fig. 203, exhibited by Bodin, of Trois-Croix, Rennes, France, is a representative machine. The grain issues from the hopper in quantities regulated by the feed-wheel, and falls between the flat surfaces of the two large rollers (0.70 meter diameter), one of which is driven by hand or pulley, while the other is moved by contact. A set-screw regulates the distance between the two rollers, and a spring permits them to separate should a stone or foreign body intrude between them.

The French grain-crusher.



Aplatisseur.

FIG. 203.—*Aplatisseur* (*grain-flattener*). *E. Bodin, Rennes, France.*

Bodin.

The work by hand is 1.40 hectoliters (22 gallons) per hour; by horse-power or steam, 5 to 7 hectoliters. The weight of the machine is 313 kilos; the price, 272 fr.

Capacity.

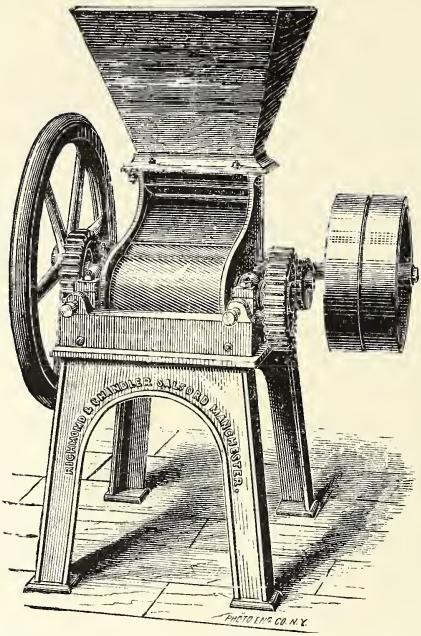
Price.

A smaller size for persons keeping one or two horses is sold at 110 fr., and grinds 11 gallons per hour; and a larger

Grain-crushers. size, weighing 500 kilos, is price 500 fr., and grinds from 10 to 15 hectoliters per hour.

The more common machine is one which has grooved rollers so as to make a rough-grinding operation. The forms of these machines are very numerous within moderate limits, and the multitude of exhibitors and excellence of the machines show the importance attached to grinding grain for animals in preference to feeding it whole.

English grain-crusher.



Richmond & Chandler.

FIG. 204.—*Grain-crusher. Richmond & Chandler, Salford, England.*

The grain-crusher shown by Richmond & Chandler, of Salford, near Manchester, England, may be taken as a specimen. It is made in various sizes, and is used for crushing beans, pease, oats, barley, maize, flaxseed, or malt.

Sizes and prices.

Measure of rollers.	Price. £ s. d.	Measure of rollers.	Price. £ s. d.
7 × 3½	5 10 0	14 × 8	16 0 0
11 × 6½*	11 7 6	24 × 11	18 0 0

Experiments with crushed feed.

The average gain in crushing grain was determined by an experiment with the omnibus horses of London, and amounts to 25 per cent.

Biddell's English grain-kibbler.

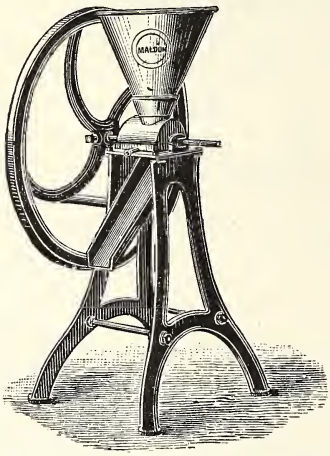


FIG. 205.—*Biddell's oats and beans kibbler. Maldon Iron Works, Maldon, England.*

Maldon Iron Works.

The "set" of the rollers is regulated by means of two thumb-screws in front of the machine, so that the grain may be crushed to the required degree of fineness. The feed of the grain to the rollers, according to the force applied to the machine, is determined by a small regulating-wheel.

In the machine of Picksley, Sims & Co., of Leigh, near Man-

* Shown in cut.

Grain-crushers.

chester, England, the rollers are of different sizes, are each driven positively, turn at different speeds, and are channeled in opposite directions.

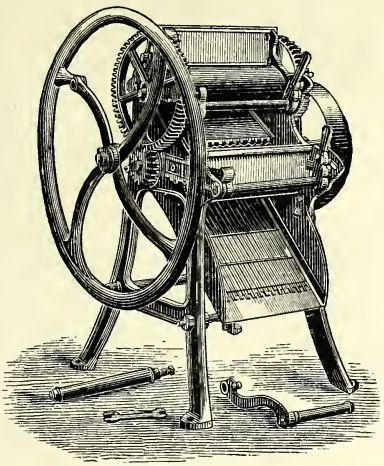
Picksley, Sims & Co.

Biddell's kibbler (Fig. 205).

The "kibbler" is designed for cracking oats, beans, and maize for horse-feed. Fig. 205 is Biddell's "kibbler," exhibited by the Maldon Iron Works, of Maldon, England. Its cost is £3 3*s*. It is like a large coffee-mill, and has renewable iron plates, with capacity for setting for various degrees of fineness.

Oil-cake an important article of feed.

Cake of cotton-seed or flaxseed is an important article of food in English and French farming. The oil-cake breaker (French, *concasseur de tourteaux*) has a hopper, into which the cake is slipped edgewise and gripped between a pair of spiked rollers, which reduce it to pieces suitable for sheep or beeves. Running down the grating, the dust is removed. For lambs, which require a finer product, the second and lower pair of rollers is put into action. The capacity is from 3,000 to 4,000 lbs. per hour.



Oil-cake breaker.

Corbett & Peele.

Corbett & Peele's oil-cake breaker makes 6 different sizes of cake-meal, and has cleaning-combs to prevent adhesion or clogging of damp cake. The plates forming the hopper are made to fall back to form a capacious hopper for broken pieces. Boxes receive the broken cake and the dust separately.

FIG. 206.—*Oil-cake breaker. Corbett & Peele, Shrewsbury, England.*

Corn-shellers.

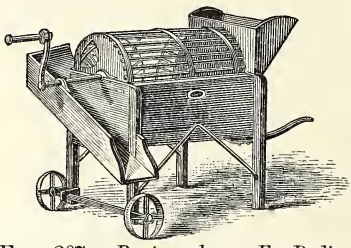
Maize is largely grown in some parts of France, but the shellers are of American models and require no notice here. Corn-shellers of English and of French make were exhibited at the Paris Exposition. Corn is principally grown in France for fodder only.

Extensive use of roots in Europe for feed.

Machinery for cutting and slicing roots will never have the same importance in the United States that they have in Europe, for our climate of excessive changes is neither favorable to the development of the roots in summer nor their preservation in winter.

As might, therefore, be expected, European nations are much ahead of us in the quantity, variety, and efficiency of their machinery for washing roots and preparing them for feeding to the animals.

Root-washer.



Bodin.

FIG. 207.—*Root-washer. E. Bodin, Rennes, France.*

The root-washer shown by Bodin, of Trois-Croix, Rennes, France, is a sample of the most usual form. The roots put into the hopper at the end are tumbled over and over in the cage, alternately in the water and out of it, and by rubbing against each other and against the bars of the cage, aided by the agitation of the water, rub and wash off the adhering soil, and are discharged at the end of the hopper. The machine weighs 160 kilos, and costs 160 fr.

Price.

Pernollet's

The root-washer of Pernollet, Paris, is all of iron except the oaken frame. The basin is of galvanized sheet-iron, painted, and is readily reached for cleansing off the collected soil by lifting the hopper and cylinder, exposing the basin to be swept and washed.

root-washer.

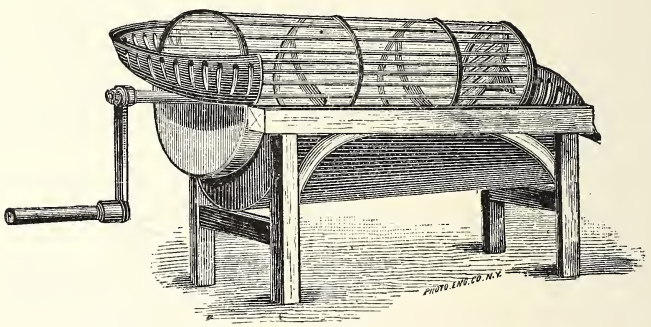


FIG. 208.—*Root-washer. J. Pernollet, Paris, France.*

Operation.

The rate is 18 to 20 turns per minute. A helix in the cylinder expels the roots. The machine is made of 3 sizes,

all of the same diameter (60 centimeters), but differing in length. *Root-cutters, etc.* Pernollet's root-washer.

Price:

	Francs.	Sizes and prices.
1.10 meter	160	
1.50 meter	200	
2 meters	300	

A potato-assorter was exhibited in the English section by Penney & Co., of Lincoln, which assorts the tubers into three grades—small for stock, medium for seed, and large for market. It rubs off the soil at the same time, and can be operated by a lad. Griffin's potato-assorter.

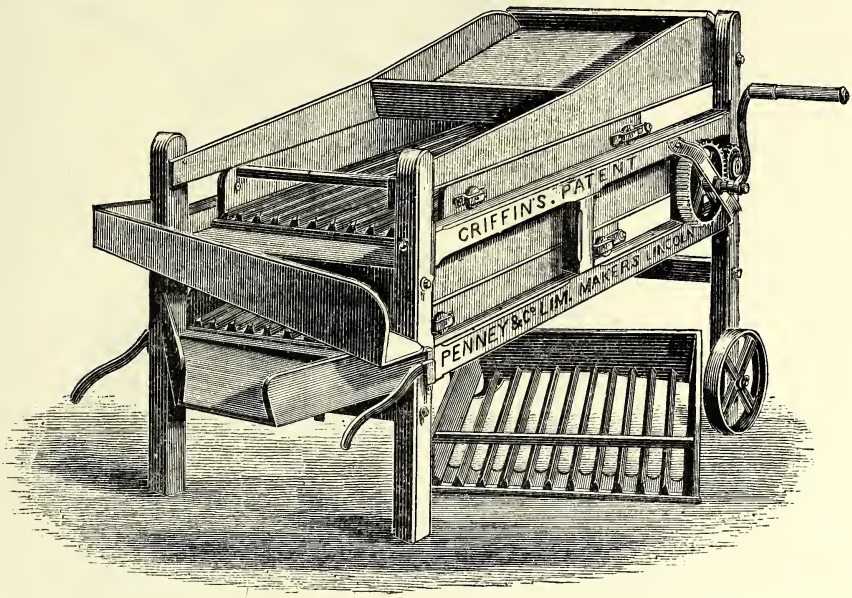


FIG. 209.—*Potato-assorter. Penney & Co., Lincoln, England.* Penney & Co.

The capacity of the small-size machine is about 1,000 lbs. per hour, and the larger size about one-half more. The rolling action of the sieves prevents lodging of the potatoes in the gratings. The sieve shown underneath the machine in the cut is placed there merely to exhibit its form and structure. Capacity. Operation.

The prices of the respective sizes are £8 10*s.* and £10 10*s.* Prices.

Except in the feeding of turnips in the ground to sheep, roots are almost universally cut before feeding. The machines vary in construction and in the shape of the slice.

Some machines make round slices by a simple transverse cut, the thickness depending upon the set of the knife beyond the plane of the disk to which the cutters are attached. This form is shown in Bodin's root-cutter. The cast-iron Bodin's root-cutter.

Root-cutters, etc. hopper has a shelving bottom, which keeps the roots up to the cutter-disk to the last piece.

Bodin's root-cutter.

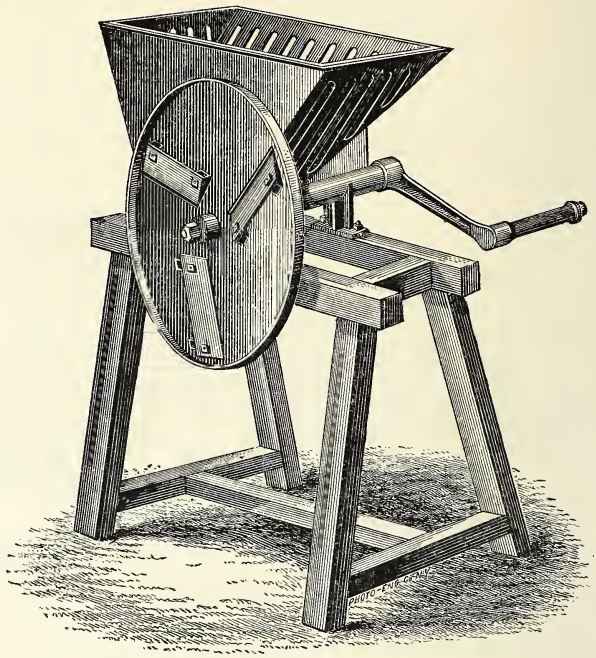


FIG. 210.—*Root-cutter. E. Bodin, Rennes, France.*

Price. The weight of the machine is 70 kilos; price, 60 fr.

Modifications of the machine. In a modification of the machine the round sections are cut into slips by means of sharp spurs projecting from the face of the disk a little in advance of the knives, which score the roots so deeply that when the knife shaves off a section it falls in slips.

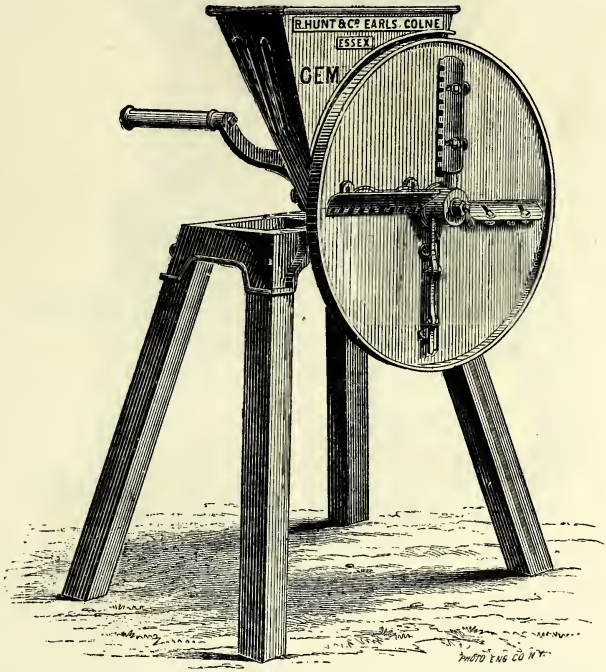
Another modification has a toothed knife (Fig. 212), as shown in the machine (Fig. 211) exhibited by Hunt & Tawell, of Earl's-Colne, Essex, England, and by several other manufacturers. It adds 5 fr. to the price of the machine.

Hunt & Tawell.

Still another modification is a form of knife with angular projections, forming V-shaped cutting edges. This, however, is not so common, and is more expensive, as well as being more difficult to grind and keep in order.

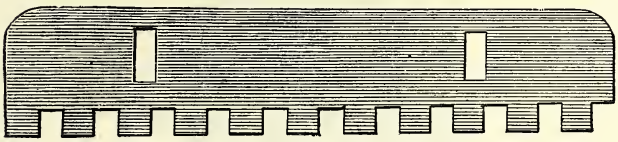
Various forms of knives. Variations in the knives for the purposes of feeding cattle, sheep, etc., are found in several machines, otherwise similar in all features. Such machines are said to rasp, pulp, shred, mince, cut (*émincer*, *râper*, *couper*, etc.), as the case may be.

Fig. 213 shows the larger machine of this character, having a disk with knives at each side of the hopper (*à double effet*). *Root-cutters, etc.* Picksley, Sims & Co.'s root-cutter (Figure 213).



Hunt & Tawell's root-cutter.

FIG. 211.—*Root-cutter. Hunt & Tawell, Earl's-Colne, England.*



Toothed knife

FIG. 212.—*Toothed knife of root-cutter. Hunt & Tawell, Halstead, England.*

Messrs. Woods, Cocksedge, & Co. had a new turnip-cutter, which cuts the roots into three distinct sizes, and thus serves the purpose of three machines. Woods, Cocksedge & Co.'s root-cutter.

One of the disks has a knife for fine cutting and the other for coarser. In the hopper is a hinged plate, which may be turned over to either side of the hopper in order to conduct the roots to the required side, according to the fineness of cutting desired. The plate covers up one disk while it forms a sloping hopper-bottom to conduct roots to the other.

The Maldon Iron Works, of Maldon, England, exhibited a machine known as a root-shredder, the disk being occu- Maldon Iron Works.

Root-cutters, etc. pied by a multitude of tearing points in the sectors between the radial knives.

Picksley, Sims, & Co.'s double-acting root-cutter.

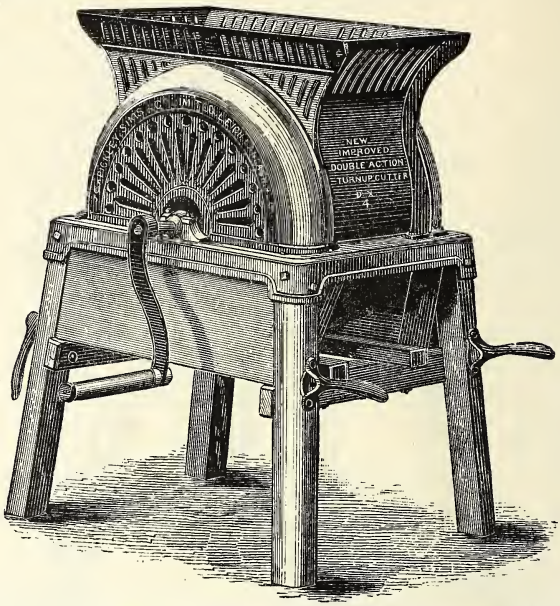


FIG. 213.—*Double-acting root-cutter. Picksley, Sims, & Co., Leigh, England.*

Prices of root-shredder.

Price:

	£	s.
Plate 24″ in diameter	3	5
Plate 31″ in diameter	4	5

Root-shredder, Maldon Iron Works.

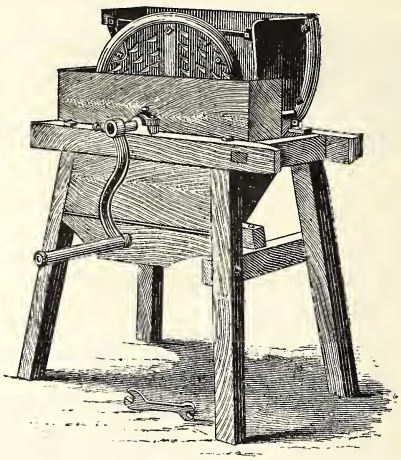


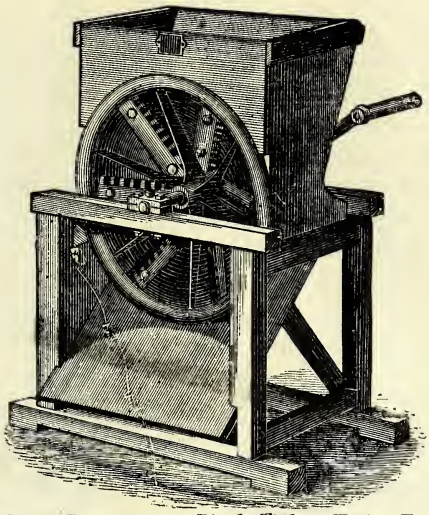
FIG. 214.—*Root-shredder. Maldon Iron Works, Maldon, England.*

Cutter cylinders.

Another form of root-cutter, but not so good as those described, has cutters on the periphery of a cylinder, the pieces passing into the interior of the cylinder either as round sections or slips, according to the style of the knives.

A better form than the cylindrical is the truncato-conical, which was exhibited by Pinel Fils in several sizes: *Root-cutters, etc.*

6 toothed knives, 2,000 kilos per hour, weighing 170 kilos, cost 126 fr.



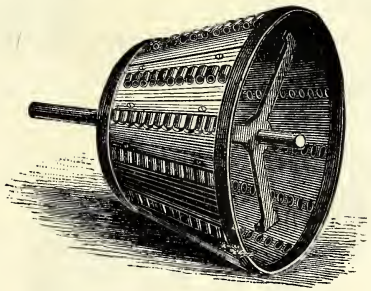
Truncato-conical root-cutter.

Pinel.

FIG. 215.—*Root-cutter. Pinel, Thil-en-Vexin, France.*

4 toothed knives, 1,000 kilos per hour, weighing 110 kilos, cost 84 fr. Price.

Fig. 215 shows more clearly the shape of the knife-cone, which, in the present instance, has 12 knives.



Frusto-conical cutter.

FIG. 216.—*Frusto-conical cutter.*

The turnip, beet, carrot, or turnip-radish are fed either alone or mixed with cut hay or straw, or with meal of maize, beans, barley, or pease.

No absolute statement can be made of the greater economy of cooked over raw food. Questions of the prices of the food, of fuel, and of labor are essential elements in the calculation. As food increases in value and labor cheapens, food-cooking apparatus come into use.

French and English exhibits. Beaume's apparatus.

France and England were the principal exhibitors in this line of apparatus. Beaume had a light and cheap apparatus of galvanized sheet-iron for cooking vegetables, grains, and roots, with capability of being used for other domestic purposes, such as clothes-washing and soap-making, and which may be used for stewing fruit for canning, if made of the proper metal.

Price.

Price, from 50 to 400 fr. for a capacity of from 25 to 500 lbs. of grain.

Portable cooking apparatus.

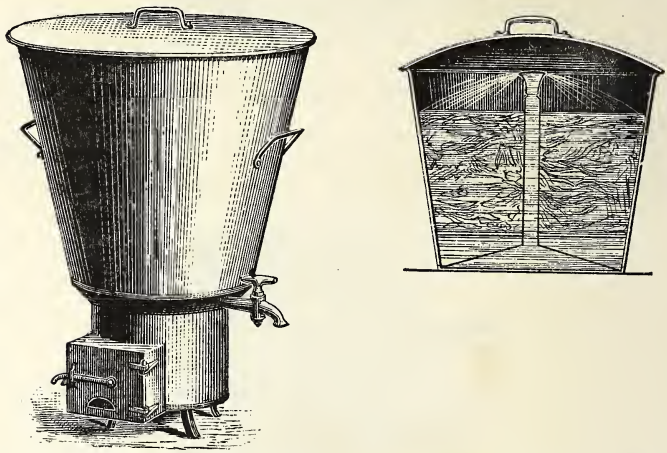


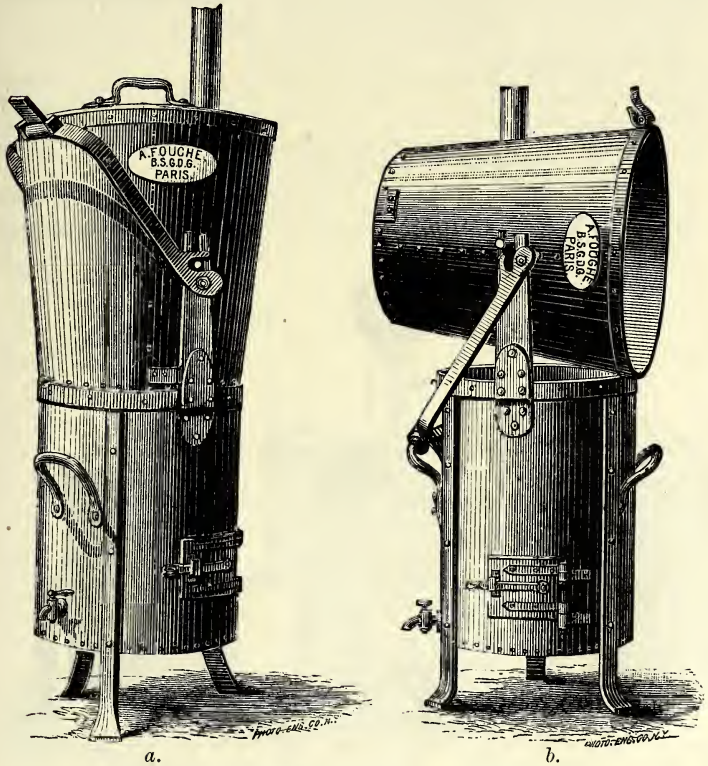
FIG. 217.—*Portable cooking apparatus. L. Beaume, Boulogne, France.*

Cooking apparatus of Fouché. (Figure 218.)

Another form was exhibited by A. Fouché, of Paris. It is made of sheet-iron or copper, and is suspended on posts rising from the sides of the furnace. When at work, the bottom of the caldron fits within the top ring of the fire-box, cleats on the vessel resting on the rim of the section beneath. When the caldron is to be discharged, it has first to be lifted clear of the furnace. This is done by means of the bail, cams on which raise the axis of suspension of the caldron, and it may then be tipped, as shown in Fig. 218 *b*.

Food-cooking apparatus. Fouché's prices.

Price:	Francs.
Containing 1 hectoliter (22 gallons)	200
Containing 2 hectoliters	280
Containing 3 hectoliters	340



a. *b.*

Agricultural caldron, Fouché.

FIG. 218.—*Agricultural caldron. A. Fouché, Paris.*

Bodin's agricultural boiler.

The cast-iron boiler and steamers made by Bodin, of Rosières, near Saint-Florent (*Cher*), are shown in Fig. 219.

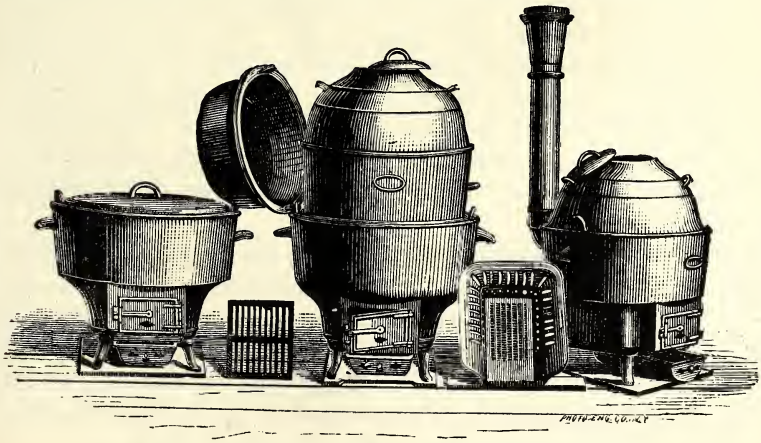


FIG. 219.—*Agricultural boiler. Bodin, Rosières, France.*

Food-cooking apparatus.

Bodin's agricultural boiler.

It has grates for wood or for coal, and has additional steaming-chambers, which increase its capacity 150 per cent., the contents of each being kept distinct. It is easily transported in sections, economical of fuel, and ready for immediate use in any place without setting in masonry.

Prices.

Price complete:

	Francs.
30 liters capacity	54
200 liters capacity	185

There are eight intervening sizes.

The English apparatus of Richmond & Chandler, of Salford, near Manchester, is shown in Fig. 220. It has a strong

English food-cooking apparatus.

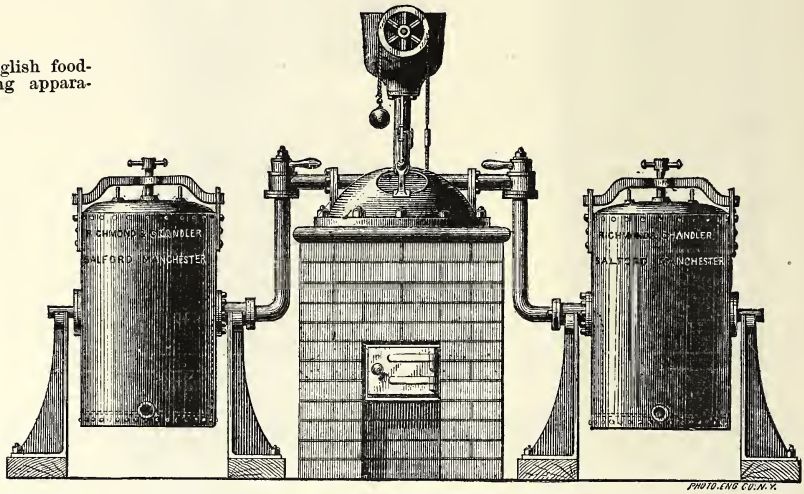


FIG. 220.—*Steam-cooking apparatus. Richmond & Chandler, Salford, England.*

Richmond & Chandler.

iron boiler, set in brickwork and provided with a safety-valve and elevated water-cistern. On one side, or both, of the boiler is a cooking-tank swinging on gudgeons, through one of which the steam-pipe passes. The cover of the tank has a gasket and is fastened down by a clamping-screw and bridge. The tank tips on its axis to discharge its contents. The height of the column of water bears the proper proportion to the pressure (and, consequently, heat) of steam required, but is shown short, for compactness, in the illustration.

Operation.

Barford & Perkins' agricultural boiler.

Barford & Perkins exhibited in the English section an apparatus of the same general construction, but the boiler was set in an iron case and required no brick-work. It is adapted for steaming hay, chaff, roots, grain, flaxseed meal, and other feed; also for boiling milk for pigs, and water for steeping other food. It is much used for stable purposes;

Food-cooking apparatus.

Barford & Perkins' agricultural boiler.

also for cooking the meat and meal fed to hunting-dogs in the very extensive kennels of Great Britain and Ireland. It is stated to be capable of steaming all the food for 50 head of cattle and as many pigs, at a cost not exceeding one shilling (English) per day, where coal is cheap. It has a wrought-iron steam-generator with feed-pump attached, a 60-gallon galvanized-iron boiling-pan, and a 9-bushel revolving root or chaff pan.

Price, complete, with 12 feet of iron flue-pipe, $150. Price.

Even the vine and wine statistics of France scarcely prepare one to view without astonishment the enormous area in vineyard cultivation in that country. The product is
Wine product. stated at 1,100,000,000 gallons. In most districts the land is held in small tracts, and the cultivation is strictly by hand, the peasants owning no horses. For proprietors somewhat more prosperous a whole series of implements is prepared specially adapted to this culture, the object being to do by animal power as nearly as possible what is performed by hand.

Hand implements. The hand process, by means of the pronged hoe, consists in drawing the soil alternately towards and from the vine, so as to keep the soil open and free from weeds. The plow is adapted to the same work, and does it as the plow used to with us in the old-fashioned method of corn cultivation, throwing the furrow alternately from and towards the corn.

The vineyard plow exhibited by Moreau-Chaumier, of

Vineyard plow.

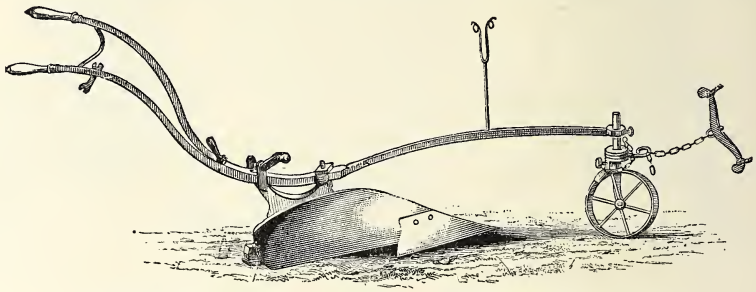


FIG. 221.—*Vineyard plow. Moreau-Chaumier, Tours, France.*

Moreau-Chaumier. Tours (*Indre-et-Loire*), is transformed by the articulation of the handles, which incline to the right to throw the soil from the vine (*déchaussement*), and to the left for throwing to the vine (*rechaussement*). A central regulator on the standard of the forward wheel enables the draft-hook to be thrown right or left, so as to transform the implement into a *déchausseuse* or *rechausseuse*, respectively. Price, 80 fr.

Price.

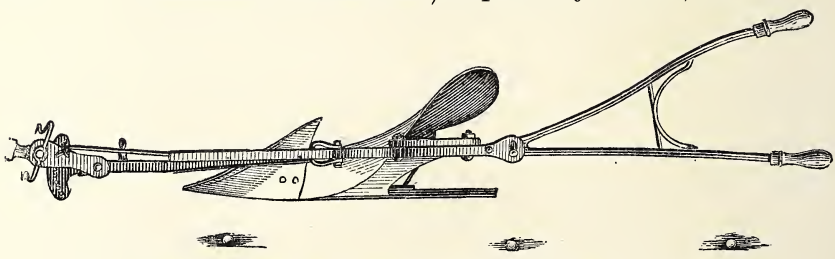


FIG. 222.—*Déchausseuse. Renault-Gouin, Sainte-Maure, France.*

Figs. 222 and 223 show the *déchausseuse* and *rechausseuse*, respectively, exhibited by Renault-Gouin, of Sainte-Maure (*Indre-et-Loire*). The adjustment for throwing away from or towards the vine is done by shifting the handles and by lateral adjustment of the draft-link on the clevis. The French plows all throw the furrow to the right, and the figures show the change quite clearly. The rows of objects represent the vines.

Vineyard implements.

Adjustable plow of Renault-Gouin (Figures 222, 223).

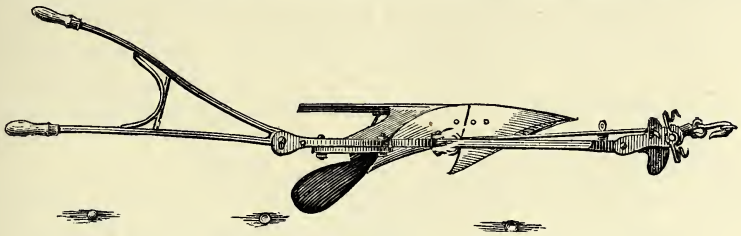


FIG. 223.—*Rechausseuse. Renault-Gouin, Sainte-Maure, France.*

A special plow is made by Moreau-Chaumier, of Tours, the depth of the point being regulated by an additional lever, which is articulated to the beam and maintained at a regulated height by mortise bar and pin at the rear. This plow has the same adjustable handle and side-draft regulator as the vineyard plow (Fig. 225).

Plow for hilly ground.

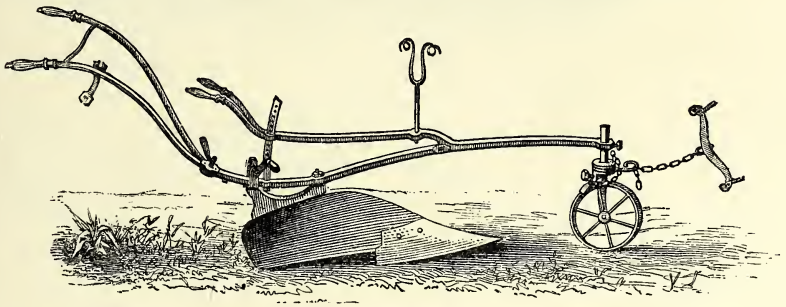


FIG. 224.—*Plow for hilly ground. Moreau-Chaumier, Tours, France.*

Moreau-Chaumier.

Price, 150 fr.

Price.

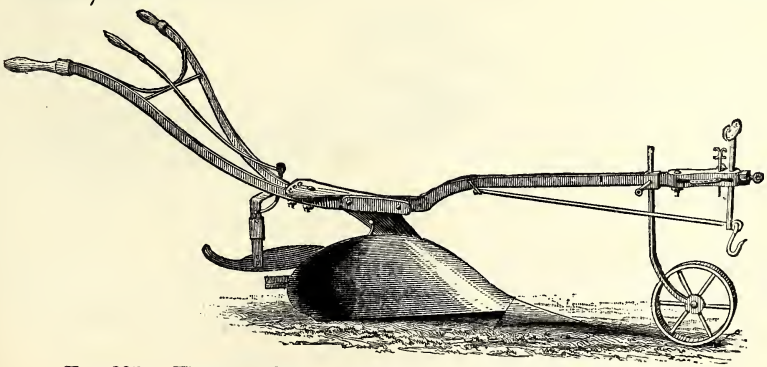


FIG. 225.—*Vineyard plow. Renault-Gouin, Sainte-Maure, France.*

Vineyard implements.

Plow with lateral cutter (Figure 225). Renault-Gouin.

Renault-Gouin also exhibited a vineyard plow (Fig. 225) with a lateral cutter (*cavaillonneur*) on the land side; this is brought into action by a lever, which causes it to project into the spaces between two vines in a row, so as not to leave strips of untilled soil between the vines. It requires the attention of the plowman to thrust it out and draw it in as he proceeds along the row.

Price.

Price, from 85 to 110 fr., according to size.

Double-moldboard plow.

The double-moldboard plow (*buttoir*) is but little used in America, but is of great value in tending root crops and vines, which are planted closer than corn usually. The

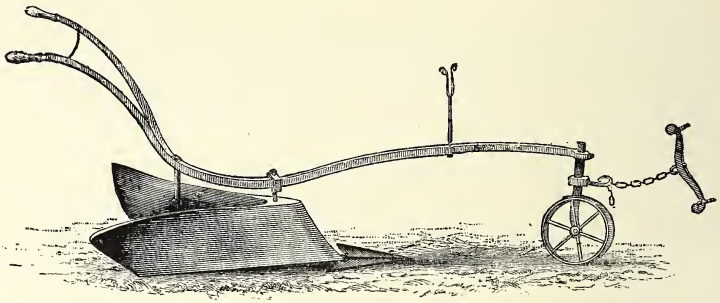


FIG. 226.—*French double-moldboard plow. Moreau-Chaumier, Tours, France.*

Moreau-Chaumier.

buttoir exhibited by Moreau-Chaumier is shown in Fig. 226. Some such plows are made with expansible moldboards, so as to ridge up the soil against each side in balks of greater or less width.

Price.

Price, 90 fr.

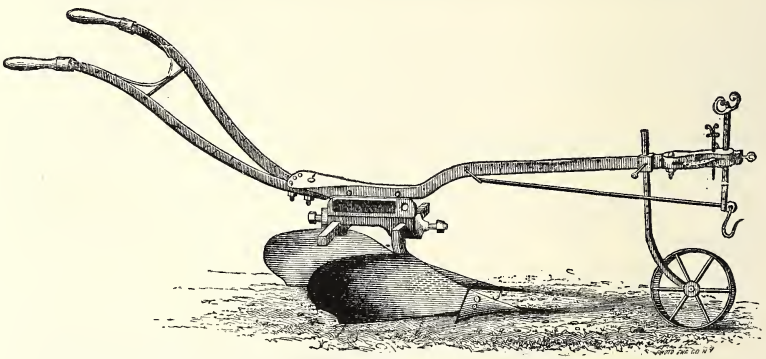


FIG. 227.—*French gang-plow for vineyards. Renault-Gouin, Sainte-Maure, France.*

Renault-Gouin's gang-plow for vineyards.

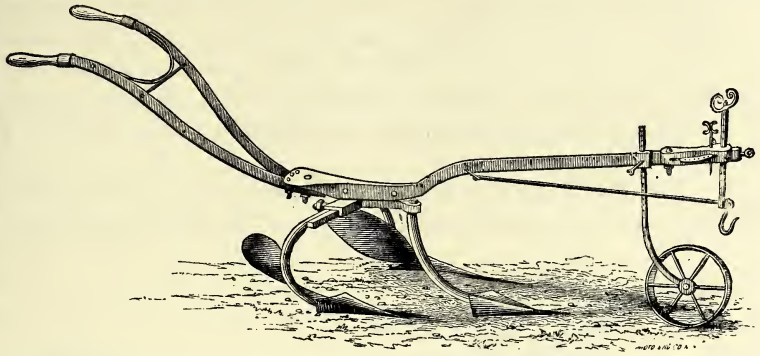
The gang-plow (*bisoc*) of Renault-Gouin is of various widths. With the larger size a balk of 1.30 meter can be fully cultivated in two rounds.

Prices.

Prices, according to size, 80, 90, 110 fr.

The vineyard plow with adjustable shares, known as the *rouelleuse* in Burgundy, was exhibited by Renault-Gouin.

Vineyard implements. Plow with adjustable shares.

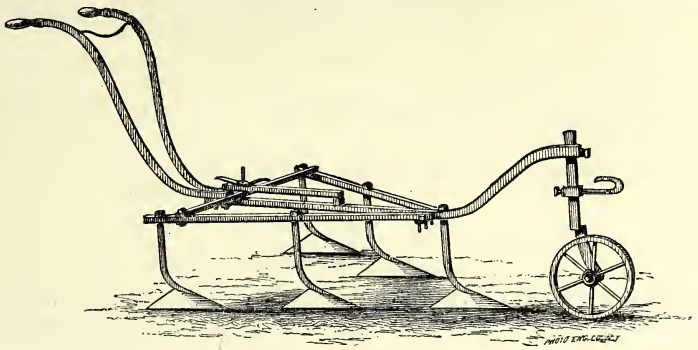


Burgundy plow.

FIG. 228.—*Vineyard plow of Burgundy. Renault-Gouin, Sainte-Maure, France.*

It throws earth from each side into the middle of the balk and then splits the ridge with a hoe. The side shares are on

Renault-Gouin.

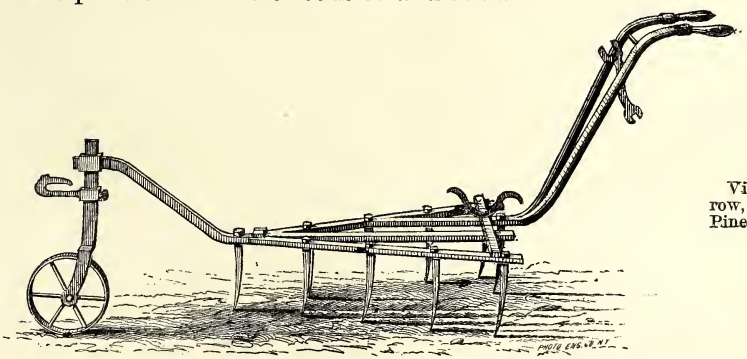


Vineyard horse-hoe, Souchu-Pinet.

FIG. 229.—*Vineyard horse-hoe. Souchu-Pinet, Langeais, France.*

bars which slip through a transverse mortise-bar below the beam, and are fastened by set-screws. The usual range of adjustment is from 60 to 80 centimeters.

The price of the two sizes is 85 and 95 fr.



Vineyard harrow, Souchu-Pinet.

FIG. 230.—*Vineyard harrow. Souchu-Pinet, Langeais, France.*

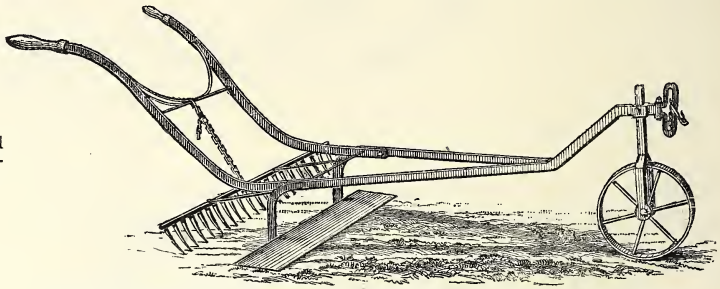
Vineyard implements.

Each of the principal exhibitors of vineyard implements had horse-hoes and cultivators. Fig. 229 shows the one made by Souchu-Pinet. It may be converted from a horse-hoe to a harrow by removing the 5 shares and replacing them by 10 teeth, as in Fig. 230. The horse-hoe costs from 60 to 70 fr.; the harrow from 40 to 60 fr. Each is expansible at the rear, the range of adjustability being from 0.40 to 1 meter.

Horse-hoe (Figure 229).

Vineyard harrow (Figure 230).

The tool known as the *paroir à vigne*, for vineyards, also for park and garden walks, is a parer for cutting weeds and grass. The rake following collects the weeds and dresses the surface.



Scraper and raker, Renault-Gouin.

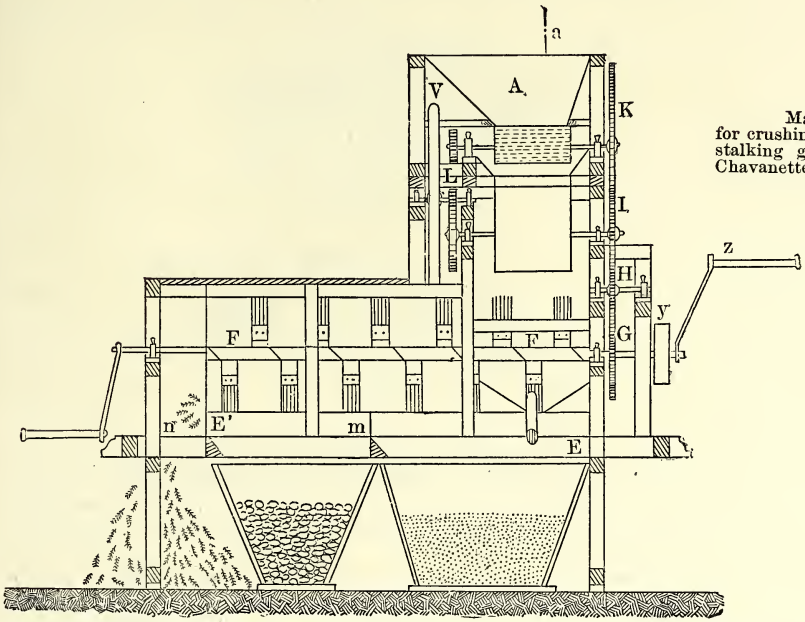
FIG. 231.—*Scraper and rake. Renault-Gouin, Sainte-Maure, France.*

Price.

Price, with rake, 55 fr.; without rake, 45 fr.

Pruning and cutting scissors, shears, and knives were in great variety, but belong to the class of cutlery and hardware.

Presses for wine are like those for cider; and those for olive oil, walnut oil, and for expressing the oils of oleaginous seeds, such as flax, colza, rape, etc., are similar in sub-



Machine for crushing and stalking grapes, Chavanette.

FIG. 232.—*Machine for crushing and stalking grapes (longitudinal vertical section). P. M. J. Chavanette, Fontenay-aux-Roses, France.*

stantial respects, though the oil-presses exceed in power probably. Presses are considered in the next section.

Description.

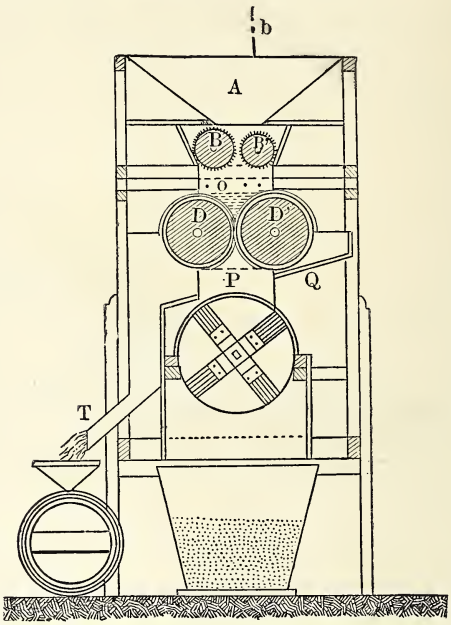
The machine for crushing, pressing, and de-stalking grapes exhibited by M. Chavanette, of Paris, is intended to do the whole duty of crushing the grape, expressing the juice, and removing the stalks, skins, and pips. Great stress is laid upon the perfect separation, on the supposition that the effect of fermentation upon the seeds and stalks is injurious to the wine, and the relative quantity of the skins in the fermentation-vat should be under control, as it is the fermenting skin which confers the color upon the wine. The value of the *dégrappage*, however, is disputed. In the *Côte-d'Or*, for instance, it is claimed that the *rafle* (stalk of the bunch) contains the ferment, bitartrate of potassa, and tannin in notable quantities, and its presence in the ferment-

Question as to the elimination of seeds and stalks.

Égrappoirs.

ing vat adds quality to the wine and assists in its conservation.

The machine is driven by hand or by power; in the former case the product is from 80 to 100 gallons per hour, and 8



Machine for crushing and stalking grapes, Chavanette.

FIG. 233.—*Machine for crushing and stalking grapes (longitudinal transverse section). P. M. J. Chavanette, Fontenay-aux-Roses, France.*

to 10 times the quantity when driven by an engine of 1-horse power.

Description.

A is the hopper into which the grapes are thrown. From this they fall between two cylinders, B B′, the outer surfaces of which have conical-headed nails, which move in close proximity, but without contact. The cylinders are separated by a distance of 5 to 6 millimeters. The crushed mass falls upon a pair of cylinders covered with sheet caoutchouc, which has a uniform thickness of 7 millimeters. The pips, stalks, and skins are drawn through, but deprived of

Operation.

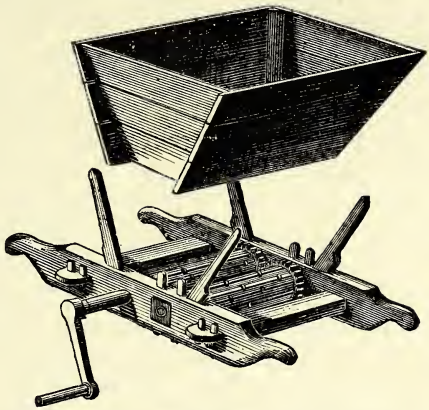
juice, which passes out through perforated plates, O, at the ends of the cylinder-box, and then, by the inclined plate Q and spout T, is discharged into a funnel and barrel. The pips, skins, and stalks drop into a chute, P, and then into a long cylindrical horizontal chamber, in which is a revolving helical brush, F F′, which drives the contents against the exterior, the lower part of which is covered with wirecloth, while the upper is of wood or sheet metal. The meshes of the portion from E to *m* are of such a size as to let the grape seeds fall through; from *m* to E′ the skins pass out,

and the stalks are ejected at the end, *n*, of the cylinder. G, H, I, K, L are gear-wheels for transmitting motion derived from the crank Z or pulley *y*. V is the fly-wheel; *a a'* and *b b'* on the respective sectional views show the lines of section, each of the other.

Égrappoirs. Chavanette's machine (Figures 232, 233).

The crushing of the grape is still performed in many parts of France by the feet of men. Earnest efforts, which one need not impugn, are making to induce the small proprietors to adopt the *écrase-raisin* or *fouloir*, which are but two names for the grape-mill.

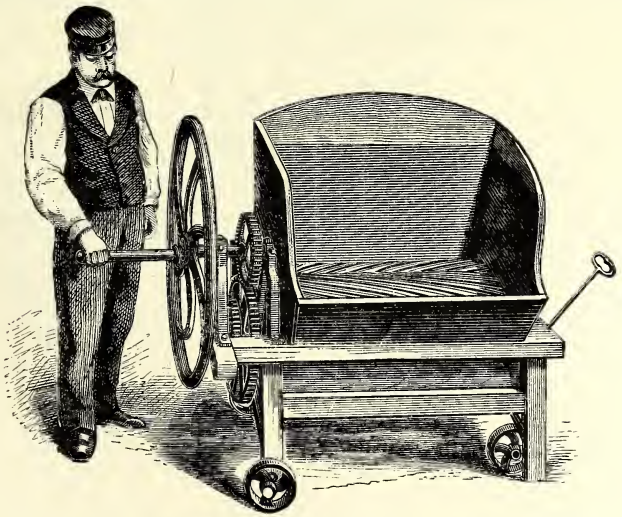
Tramping in the vat.



Grape-chrusher, Meixmoron de Dombasle.

FIG. 234.—*Grape-crusher. Meixmoron de Dombasle, Nancy, France.*

The grape-crusher shown in Fig. 234 was exhibited by Meixmoron de Dombasle, of Nancy, and is a light machine,



Grape-mill Mabille Frères.

FIG. 235.—*Grape-mill. É. Mabille Frères, Amboise, France.*

driven by hand, and placed above the vat. It has two wooden rollers, and rods upon them which act as teeth to draw

Égrappoirs. in and crush the grapes which are thrown into the hopper. The keys allow the juxtaposition of the rollers to be regulated. The work performed is 2,000 kilos of grapes per hour; the weight is 80 kilos; the price 60 fr.

Grape-mill, Mabille Frères (Figure 235). The grape-mill exhibited by Mabille Frères, of Amboise, is shown in Fig. 235. The teeth on the rollers are spiral, and the action is one of tearing as well as cutting. It is stated to be the "*usage du Midi*," a great and important grape region. The prices and sizes vary from 200 to 240 fr., with cylinders from 0.80 meter to 1 meter in length.

Some other forms of apparatus connected with the vintage and with the treatment of must and of wine were

Cellar pumps. shown in the annexes of the Quay d'Orsay, such as pumps for the delivery of the must from the press-tank into the fermenting-vats, and for transferring it from one vat to another and into casks. These, however, are but forms of pumps, and, as such, outside of the limits proposed by the writer, as they trench upon the work of another jury. The

Must-heaters. must-heaters, attracting a good deal of attention just now, were shown of several kinds, but are simply pumps which cause the liquid to pass through pipes exposed to the heat of a charcoal fire and deliver it again into vats. The subject was not particularly studied by the writer, who was attached to the mechanical and not to the chemical division of the group, and he cannot, therefore, offer anything valuable to the reader.

Curtis's wine-heater. A silver medal was granted, in Class 76, to J. M. Curtis, of San Francisco, for his must and wine heater.

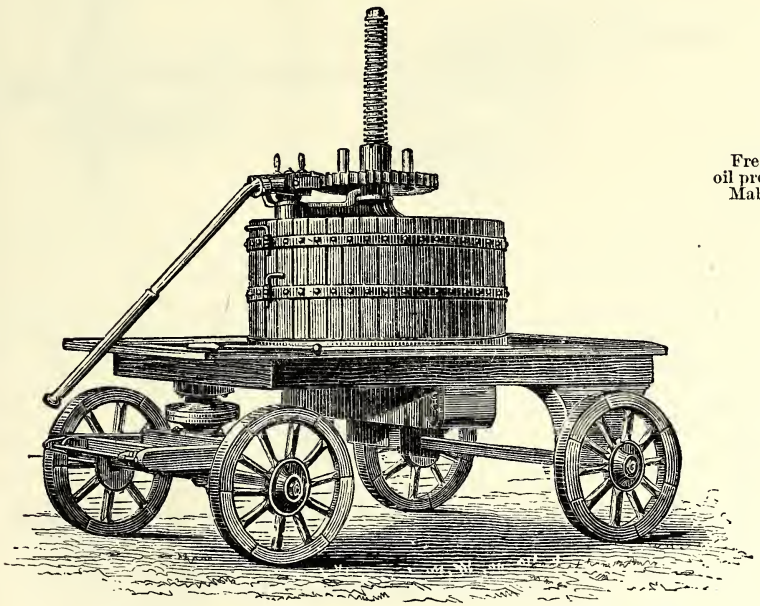
Wine, cider, and oil presses.

The French need of presses is much greater than our own. The culture of the vine is one of the most important industries of France. In the south of France the olive is a very important crop, and in Normandy the apple is equally so.

Numerous uses for presses in France.

The number and variety of the French presses for agricultural purposes were very great, and some of them well worthy of our attention. But little of importance was shown from England in that line. A cider-press from the west of England was a fair working machine, but had nothing remarkably new. The Continent of Europe, outside of France, had few presses. The vine and the olive are growing interests with us; the apple for cider is more important than either in the Northern States, though its culture is not generally in such extensive tracts as the vine occupies in spe-

Great variety of presses in France and on exhibition.



French cider or oil press. Mabille Frères.

FIG. 236.—*French cider or oil press. É. Mabille Frères, Amboise, France.*

cially favorable regions, or as the olive will shortly demand in California.

The screw-press is the most common French form. Fig. 236 shows one mounted on a carriage for transportation, it being a common practice in Normandy for parties owning

Screw-press the most common form.

Wine, etc., presses. presses to go from farm to farm to make cider, much as the thrashing machines do the work of a neighborhood with us.

Mabille Frères' screw-press for wine or oil.

(Figure 236.)

The machine has movements of two powers. When the pinion is out of gear with the nut-wheel on the screw, the wheel may be turned rapidly by means of the upright handles, either to elevate or depress it. When great power is required the gravitating-catches are dropped into their seats, and then each back-and-forth movement of the lever rotates the nut-wheel.

Mabille Frères, of Amboise (*Indre-et-Loire*), France, make these presses of 11 sizes, ranging as follows:

Sizes and prices.

Power	kilos..	30,000 to 300,000
Trough	square meters..	1.00 to 3.20
Diameter of hoop	meters..	0.65 to 2.60
Height of hoop	do....	0.60 to 1.00
Cubic contents of hoop	hectoliters..	2.00 to 53.00
Diameter of screw	meter..	0.05 to 0.15
Price	francs..	150 to 1,870

Bodin's constant movement screw-press.

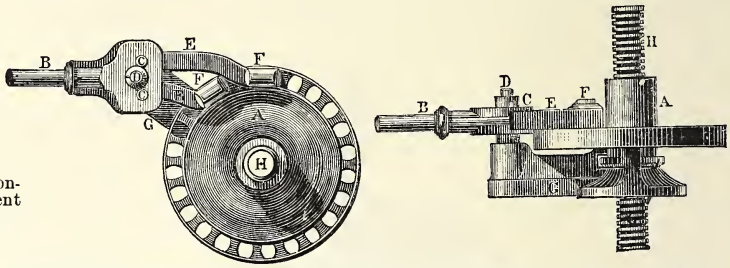


FIG. 237.—*Constant movement for agricultural presses. E. Bodin, Rennes, France.*

E. Bodin, of Trois-Croix, near Rennes (*Ille-et Vilaine*), France, has a somewhat similar mechanism, which also has a movement at each stroke of the lever.

Description.

A, mortise-wheel on the pressure-nut.

B, working-lever for giving the pressure.

C, the pintles of the coupling-rods E E.

D, axis of the working-lever.

E E, coupling-rods transmitting the movement of the lever to the mortise-wheel A.

F F, cotter-keys.

G, frame (*crapaud*) to support the mechanism.

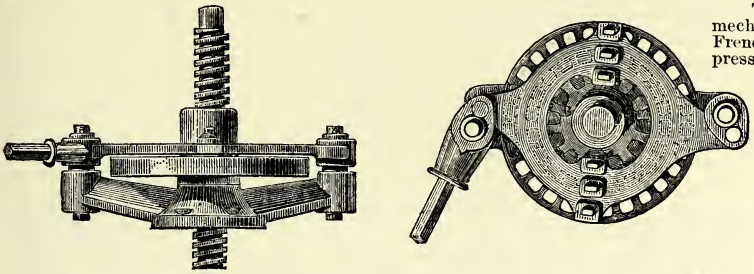
H, pressure-screw.

The cotter-keys are gravitating; each motion of the lever turns the mortise-wheel in a constant direction, the action of the cotters being alternate. While one cotter is effective the other slips up out of its seat, slides over the intervening space, and drops into the next mortise. The stroke of the lever is 0.8 meter.

Wine, etc., presses.

It may not be out of place to mention that, whatever plan of grinding the apple and pressing the pomace may be adopted, importance is attached in France to allowing the pomace to rest 24 hours before pressing. The extraction of the juice is thereby rendered more easy, more complete, the juice is fuller flavored and sweeter, and the admired golden color developed.

Time allowed for maturation of the pomace.

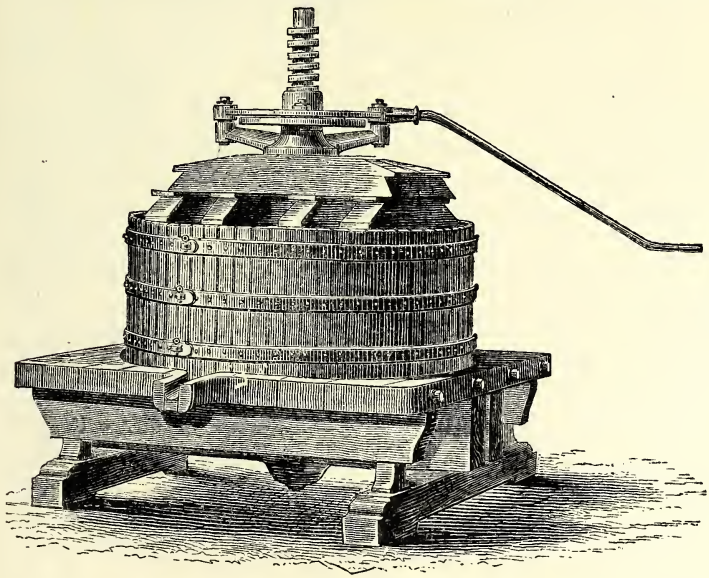


Three-speed mechanism of French screw-press.

FIG. 238.—*Three-speed mechanism of apple-press. F. Marmonier Fils, Lyons, France.*

Figs. 238 and 239 show the press of three speeds exhibited by Marmonier Fils, of Lyons. Three different powers are obtainable by dropping the cotter-keys into one or another of the circles of mortises; the smaller the circle the greater the speed and the lower the power. The upper plate oscillates on two centers as the lever is vibrated. As with the

Marmonier Fils.



Lever differential speed screw-press.

FIG. 239.—*Lever differential press. F. Marmonier Fils, Lyons, France.*

press formerly described, each motion of the lever moves the mortise-wheel, and consequently the pressure-nut, in the

Wine, etc., presses. same direction, the cotters being alternately effective, and during their ineffective stroke slip up, slide, and then fall into Marmonier Fils. the next notch. To reverse the action of the press the cotters Differential speed screw-press. are turned half round, when they turn the mortise-wheel in the other direction.

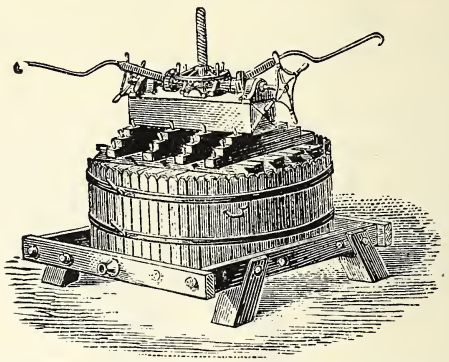
The size and price are as follows:

Size and price.

Diameter of screw	meters..	0.06 to 0.15
Length of screw	do....	1.80 to 3.20
Diameter of mortise-wheel	do....	0.35 to 1.25
Capacity of hoop	hectoliters..	5 to 100
Weight of screw, with apparatus complete	kilos..	100 to 1,300
Price of screw, with apparatus complete	francs..	80 to 600
Price of press, complete	do....	240 to 1,850

The press exhibited by David, of Orleans (*Loiret*), France, has three powers. The quickest and least forcible is the

Wine and cider press.



David. FIG. 240.—*Wine and cider press. H. David, Orléans, France.*

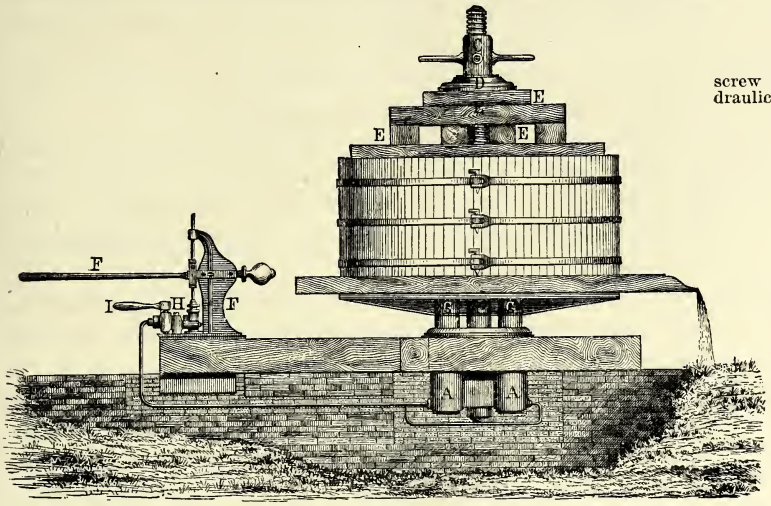
horizontal wheel on the screw; this has four handles, by which it is quickly turned. As greater power is required, Three speeds. a pinion on the horizonal axis is engaged with the wheel, and this is rotated by hand-wheels at the extremity of the axis. A still greater power is obtained by levers with a click and ratchet movement, like that known as the patent windlass.

Hydraulic presses. Presses on the hydraulic principle were exhibited by Mannequin, of Troyes (*Aube*), France, but resemble the familiar stearine and linseed-oil presses. The same exhibitor also showed the combination of the screw with the hydraulic, the latter being used to raise the platform and cheese against the follower as a final operation. The more powerful screw mechanisms are dispensed with, as the quicker and initial pressing only is done by means of the screw.

Combined screw and hydraulic press. In the figure, A A are the cylinders and G G the pistons (2 to 4 in number) of the hydraulic press, the pump F of which is set upon the same foundation, or upon the wagon,

for the machine is sold mounted on wheels if desired. The pomace, grapes, olives, nuts, or seeds being placed in the hoop

Wine, etc., presses.

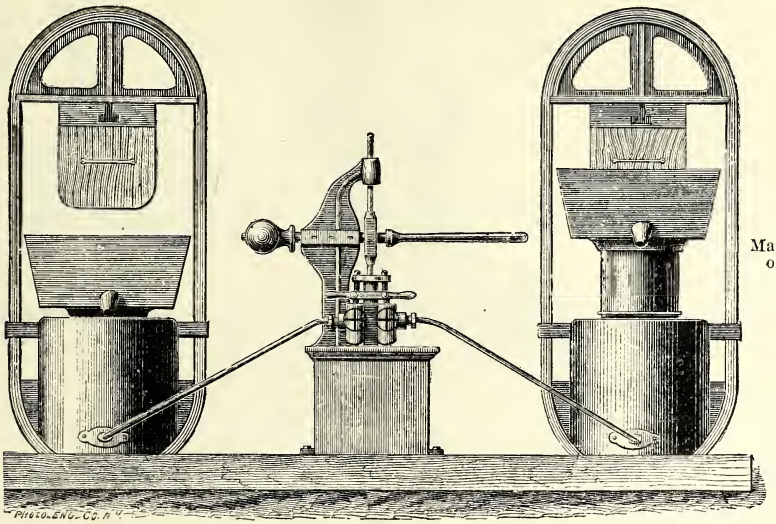


Combined screw and hydraulic press of

FIG. 241.—*Hydraulic press. Mannequin, Troyes, France.*

(*cuveau*), the follower put upon the contents, the accessory blocks E and the iron-plate D placed, the nut C is rotated downwardly on the screw B by means of the handles.

Mannequin.



Mannequin's oil-press.

FIG. 242.—*Hydraulic oil-press. Mannequin, Troyes, France.*

The hydraulic pump is then worked, and the water driven into the cylinders lifts the pistons, the table, and the *cuveau*, the nut above affording the resistance. When the required pressure is obtained and maintained for awhile, to allow the wine to escape from the marc, the cock I is opened, and the

Mode of operation. (Figure 241.)

Wine, etc., presses.

water returns from the cylinder, driven back by the weight of the table and its contents into the reservoir. In pressing grapes, the marc is then cut and returned to the *cuveau*, and the operation repeated.

Mannequin's press. (Figure 241.)

Sizes.

They are made of sizes containing from 1,300 to 5,000 liters; pressure from 170,000 to 300,000 kilos.

Mannequin's oil-press. (Figure 242.)

The hydraulic press for nut oil, colza, rape and turnip seed, and other expressed oils is shown in Fig. 242. The follower enters the basin which is on the summit of the piston of the hydraulic press. The pistons are worked alternately by a single pump.

Combined press.

M. Fort, of Montargis (*Loiret*), exhibited the screw-press with the supplementary hydraulic press, the machine mounted as a cart for transportation.

Fort.

Combined screw and hydraulic press.

A very compact combination of the screw and hydraulic press was shown by Cassan Fils, of Jallieu, near Bourgoin (*Isère*), the hydraulic mechanism being in the sole of the pressure-block beneath the nut on the screw of the press

Cassan Fils.

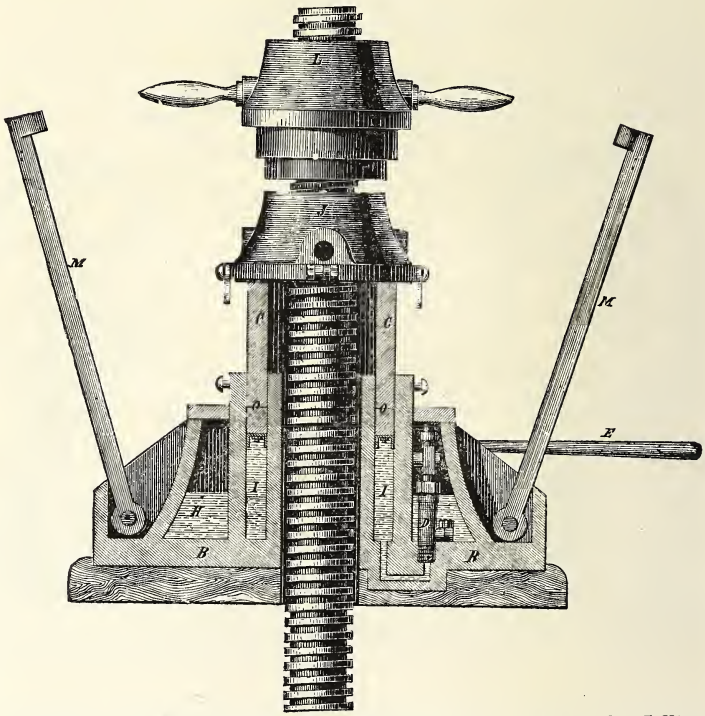


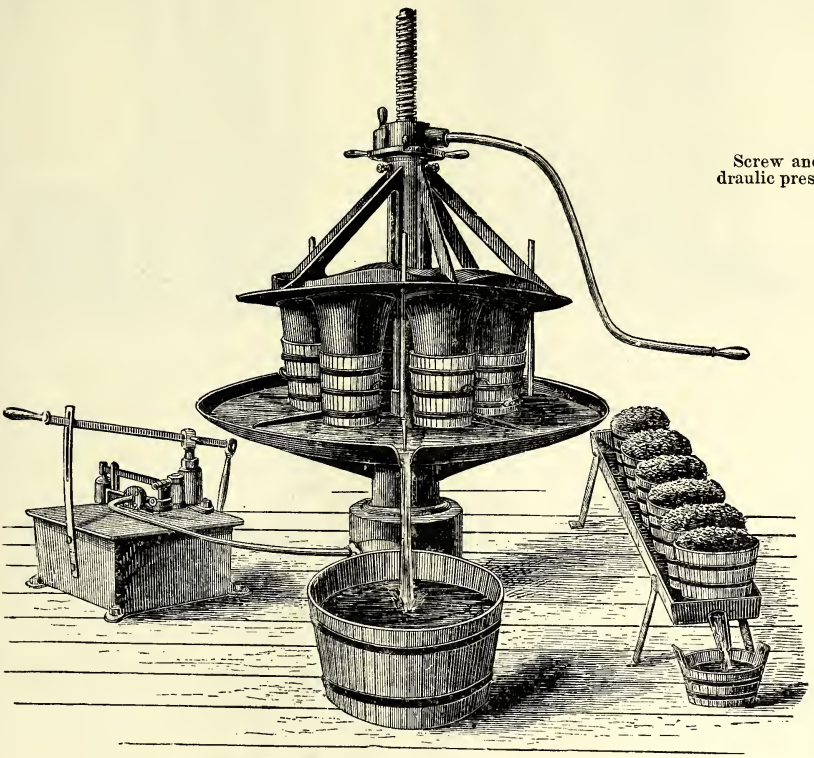
FIG. 243.—*Combined screw and hydraulic press. Cassan Fils, Jallieu, France.*

Description.

The vertical fixed screw has two nuts, L and J. When high pressure is to be applied, the tank H is filled with water, the valve of egress closed, and the lever E of the pump

worked. The sole B descends as the water from the cistern H is driven by the pump D into the cylinder I beneath the piston C. As soon as the circular mark O O appears, the course of the piston is complete. *Wine, etc., presses.*

To sustain the pressure, the props M M are brought beneath the nut L, which is adjusted in height to suit the occasion. The exit-valve of the cylinder is opened, and the water returns into the tank H. The nut J and the piston C then descend until the latter is at the bottom of the cylinder. The valve is then closed, the pump worked, and the sole B driven down again as before. Combined screw and hydraulic press. Cassan Fils. (Figure 243.)



Screw and hydraulic press.

FIG. 241.—*Wine and cider press. Quillet, Paris, France.*

The combined screw and hydraulic press of M. Quillet, of Paris, stands upon the piston, which forms a single stem, the hoops or crates which hold the marc being arranged upon the table beneath an equal number of compressors, which depend from the plate above. The size of these compressors bears a certain proportion to that of the crates, both being truncato-conical, so that when the full pressure is brought to bear and the press at the end of its stroke, but a thin layer of marc is around the compressors, and Quillet. Description and mode of operation.

Wine, etc., presses.

consequently the juice is expressed with great facility and completeness.

The *pressoir-décuplé*, so called (though but six crates are

Single crate wine or cider press. Quillet.

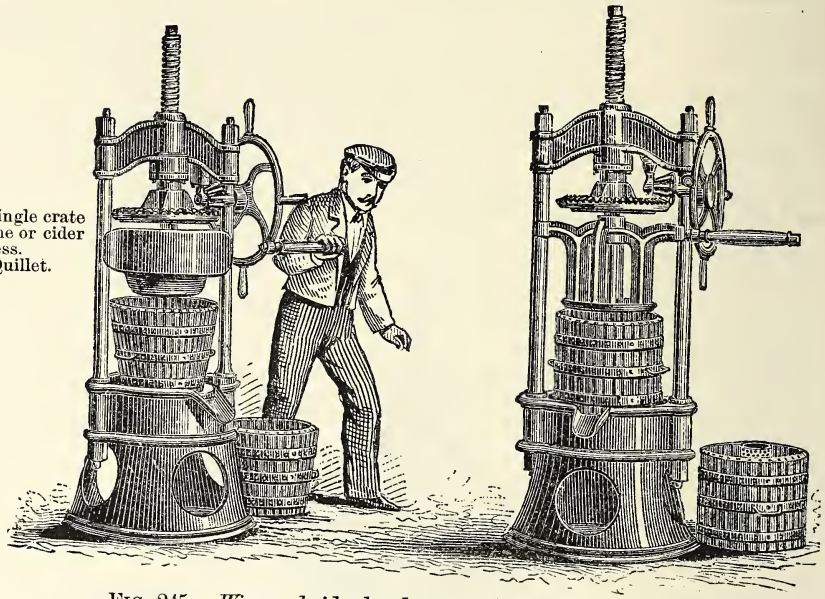


FIG. 245.—*Wine and cider hand-press. Quillet, Paris, France.*

Toggle-press.

Samain.

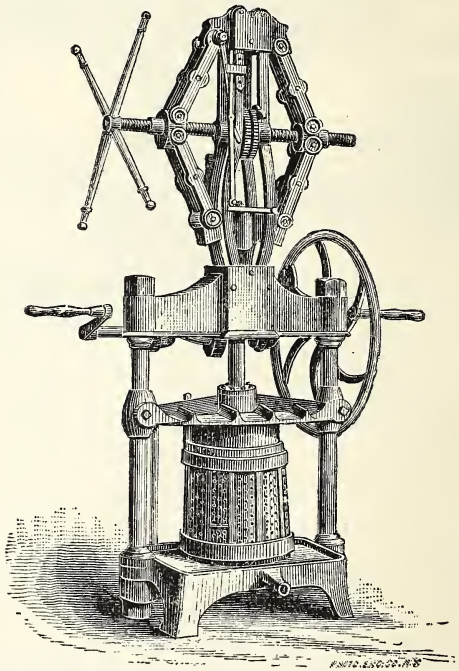


FIG. 246.—*Toggle-press. Samain, Blois, France.*

Wine, etc., presses.

in the press at once), is claimed to have a double effectiveness over a press acting upon an equal amount of marc in a single receiver; this is on account of its being exposed in a comparatively thin film, with largely increased exuding surface.

Quillet's combined screw and hydraulic press. (Figure 244.)

The press is, in fact, the union of six small presses on a single table, which is raised by hydraulic power lifting the crates, which are accurately placed beneath the pendent pistons or followers.

Quillet's single crate press.

The small press (Fig. 245) has the same features of crate and follower. In one illustration the crate is conical, and the juice issues only externally. In the other the crate is cylindrical, and the juice issues both centrally and externally.

(Figure 245.)

The power is by a hand-wheel pinion, master-wheel, and screw.

The price of the conical arrangement is 500 fr., including two crates; of the cylindrical, 550 fr., with two crates. For 100 fr. additional either is mounted on wheels.

The duration of pressure is 10 minutes with red wines. White wines require longer time, as is well known.

Toggle-press.

Samain.

(Figure 246.)

The toggle-press for wine and cider was exhibited by Samain, of Blois (*Loir-et-Cher*), France, and is intended to be worked by hand or steam. For the lower power the machine is worked by the crank, but when the higher power is required the upper handles are used to extend the arms of the toggle-levers. This flexor and extensor movement is found in some of our own presses, and is both powerful and compact.

The machine is a good one, and the powers and prices are as follows:

Crate, follower, etc.

Samain's press.

Force of press.	Area of table.	Price.
Kilos.	*Meter.*	*Francs.*
40, 000	.90	1, 650
50, 000	.90	1, 780
60, 000	1.00	2, 250
100. 000	1.00	4, 200

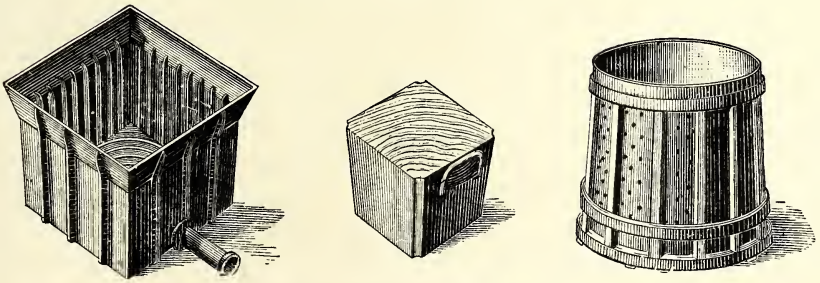


FIG. 247.—*Caisson, tampon, and barrel for oil-press. Samain, Blois, France.*

Wine, etc., presses.

Samain's crate and follower.

(Figure 247.)

Fig. 247 shows the cast-iron box or caisson for containing the olives or other oil-producing fruit; the wooden plug or tampon which enters the box and expresses the material towards the sides as well as downward; also the sheet-iron barrel with perforated sides.

But little idea of the great quantity and variety of presses at a French Exposition can be formed from an acquaintance with our own exhibitions, where they form so unimportant a feature.

Dederick & Co.

The American baling-presses of Dederick and Dodge exhibited at the Exposition were adjudged superior to all others for work on a large scale. The former, the Dederick & Co. continuous baling-press, of Albany, N. Y., was shown in the American annex, and had what may be termed a plunger or piston in connection with a reciprocating feeder, which drove a bunch of hay within the range of the plunger before each stroke of the latter.

Description.

Gold medal and Sèvres vase.

The machine received a gold medal, and also the special prize of a Sèvres vase for exceptional merit at the trials on the *Esplanade des Invalides*, August 4, 1878.

Dodge press exhibited by Pilter, of Paris.

The Dodge press was exhibited by the French agent, Th. Pilter, of Paris, in the French section of the building on the *Champ de Mars*. The award therefor was made to M. Pilter. It received a Sèvres vase also, at the trial before mentioned.

Sèvres vase.

Description of the Dodge baling-press.

In the Dodge machine the hay is thrown loosely on the feed-table or troughs in front of the press, whence iron teeth carry it right into the open mouth of the machine, when it is seized by the revolving cones in the head-piece and drawn in from the feed-table in two continuous streams, and built up into a bale 26″ in diameter. The diameter of the bale is never increased, but the bale grows longer as layer after layer is built up. In doing this, the density of the bale is regulated by the friction-clutch, which has been previously made tight. After the bale is built such length as desired, the action of the compress-screw is brought into play by simply shifting one cog-wheel, and in a few seconds the bale is compressed endwise and shortened from about one-fourth to one-fifth its length without increasing its diameter. While the compression is going on, the man attending the press is passing around and fastening the two wires. When this is done, the pressure is released, the bale dropped out, and the press set for another bale.

Superiority of large size American baling-presses.

No European machines approached in efficiency the two American presses, but in the smaller kinds, operated by hand, some of the French presses were fully equal to the American of the same class.

Decker & Mot.

Decker & Mot, of Paris, exhibited a hay-press with two screws, one on each end of the beam which depressed the

Baling-presses. follower. It was stated to be an "American" press, and was of a form of which we have many examples.

Hercules Lever-Jack Co. The Hercules Lever-Jack Company, of Newark, N. J., had an efficient small press, which received a silver medal. It is an application of the lever and pawl to the purposes of a press.

French use of small baling presses for trussing. The French use small baling-presses much more than we do, and in many ways that we do not. It is not uncommon to truss or bale all the straw coming from a thrashing machine, and so mow it away in the barn in convenient bunches for handling and feeding.

Whether it is the military habit carried into domestic life or not, it is the case that the practice of putting up feed

Guilhem's trussing-press.

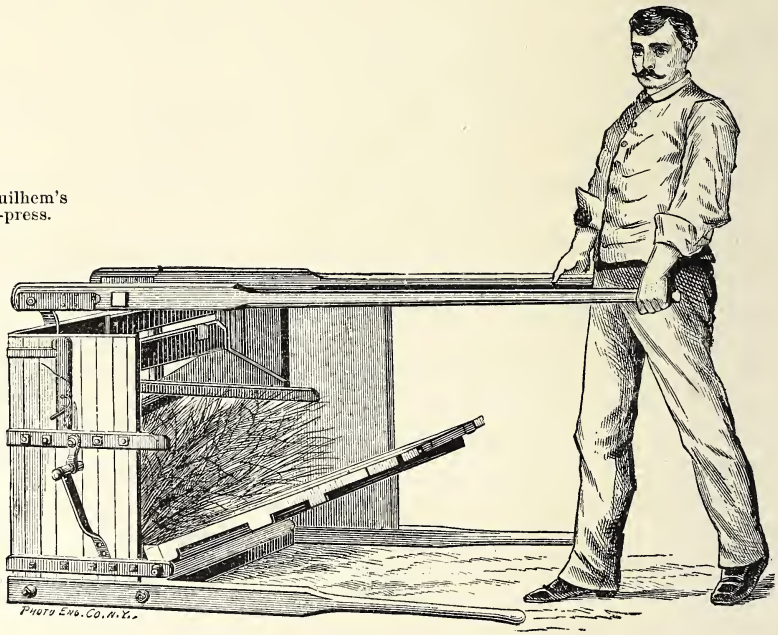


FIG. 248.—*Guilhem's trussing-press, No.* 3.

in the shape of forage rations is very common, and many presses are made for this purpose.

Two of these may be shown, and are known in the trade as "machines for trussing or bunching forage or straw."

The machine made and exhibited by M. Guilhem, of Paris, is shown in two sizes, one of which is open and the other closed.

The prices are according to capacity. Machines to make bunches of from 3 to 10 kilos weight (say from 6 to 22 pounds) are sold at from 40 to 65 fr.; 18 fr. additional for mounting on wheels.

Prices.

The operation of the machine is readily understood from the engravings. The press No. 4 will condense from 300 to 450 pounds of hay into a cubic meter of space. *Baling-presses.* Capacity.

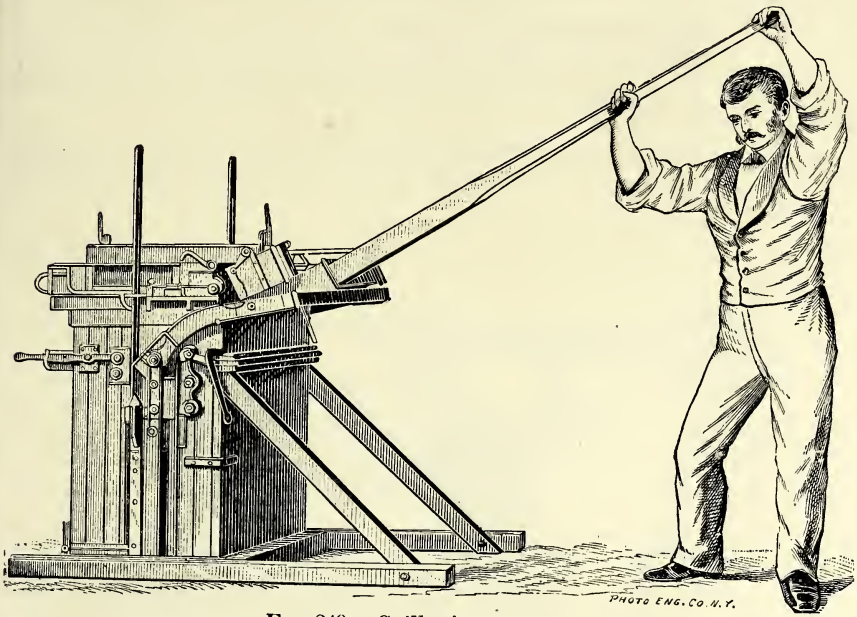
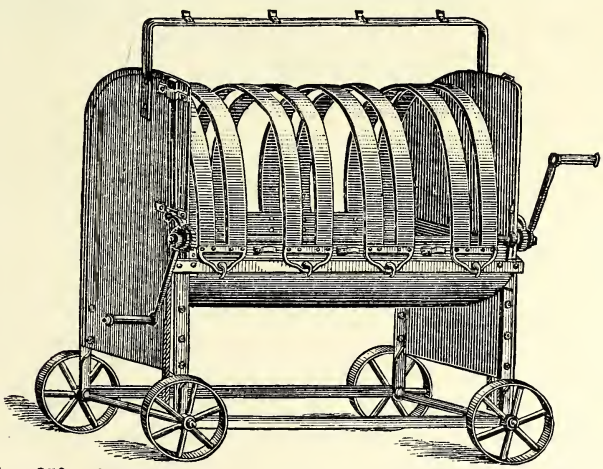


FIG. 249.—*Guilhem's press, No.* 4.

The ties are made with hempen twine or osier bark.

Several forage-presses were exhibited by M. P. Guitton, Guitton's forage-presses. (Figures 250, 251.)



Guitton's forage-press.

FIG. 250.—*Forage-press. P. Guitton, Corbeil, France.*

of Corbeil (*Seine-et-Oise*), France. The larger size (Fig. 250) is on wheels and has four flexible bands, and the smallest one of the set, shown in Fig. 251, has three pliable steel

Baling-presses. bands, which are laid back against the bar (one is shown in this position) while the crate is being filled. The bands are then laid over, the ends brought down in front, and secured to hooks. These are forcibly drawn down by pressing the foot on the treadle, each band being in turn attached, a catch holding each firmly until the encircling cord is placed and tied. Each steel band being then released, the bundle is thrown out.

Prices. The prices are from 60 to 80 fr. for machines making bundles from 30″ to 40″ long. The larger size, at 250 fr.,

Guitton's ration-press.

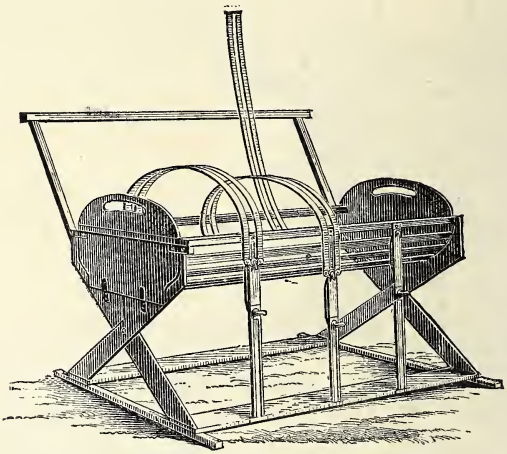


FIG. 251.—*Ration-press. P. Guitton, Corbeil, France.*

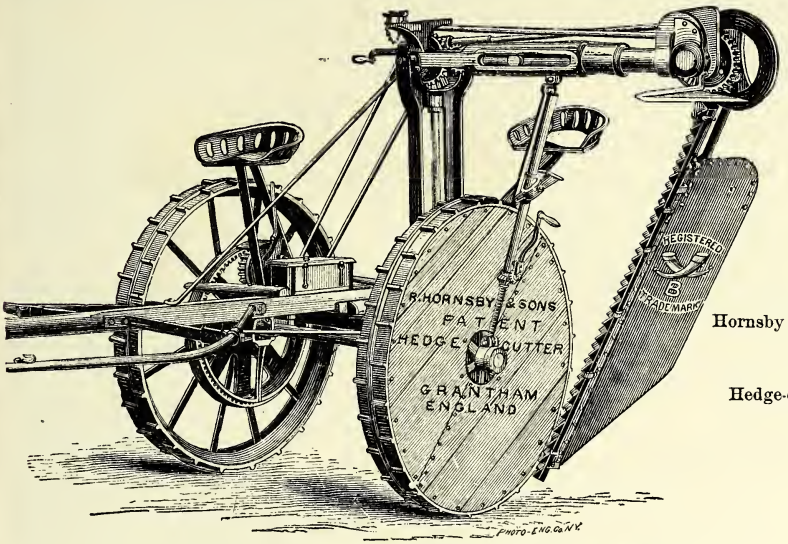
Capacity. made on the same principle, but mounted on wheels, makes bundles of from 60 to 80 lbs. weight.

Hedge-clipping machines.

The question of fences and hedges is and will long continue to be interesting to us in the United States. It has been said, though probably not an exact estimate, that the fences in the United States have cost more to build, and still cost more to keep in repair, than all the farm houses and their outbuildings, barns, and stables.

Hedges *vs.* fences.

If this be true, the time may come when we shall prefer the French plan, abolish fences and keep the animals in



Hornsby & Sons.

Hedge-cutter.

FIG. 252.—*Hedge-cutter. Hornsby & Sons, Grantham, England.*

stalls and yards. In this connection it may be said that an acre of ground will keep two or three times as many cattle in stalls as it will if pastured, and the manure be worth ten times as much.

Soiling *vs.* pasturing.

We have several hedge-trimmers patented in the United States, mostly simple modifications of the mower.

A special construction on the same principle is a late machine of Hornsby & Sons, of Grantham, exhibited at the Royal Agricultural Society's show in England.

The road-wheels are larger and are somewhat differently geared, and the parts are more massive on account of the machine being required to cut wood, in some cases when hedges have been neglected, as much as an inch in diameter.

Hornsby & Sons.

Hedge-cutter.

Hedge-clipping machines.

The top horizontal bar supports the cutter, which has the motion familiar in England in the "Paragon" machines of this firm, and can be raised, depressed, put farther out laterally, or withdrawn behind the machine, at the will of the operator.

Hornsby & Sons. (Figure 252.)

In passing trees or other obstructions, for instance, the bar is drawn back laterally and restored again to working position when the object is passed.

The stated amount of work is five miles of hedge per day; whether on one side or on both sides and top is not exactly defined.

Electric light in agriculture.

Among the numerous applications of the electric light for public and private uses is one by M. Albaret, of Liancourt (*Oise*), who has devised an apparatus for lighting up a field so that work may be carried on at night when necessary.

Albaret.

It was shown for the first time during the recent official trial of reapers, binders, and mowers at Marmont, department of *Seine-et-Marne*, July 22, 1878.

For night-work during harvest, etc.

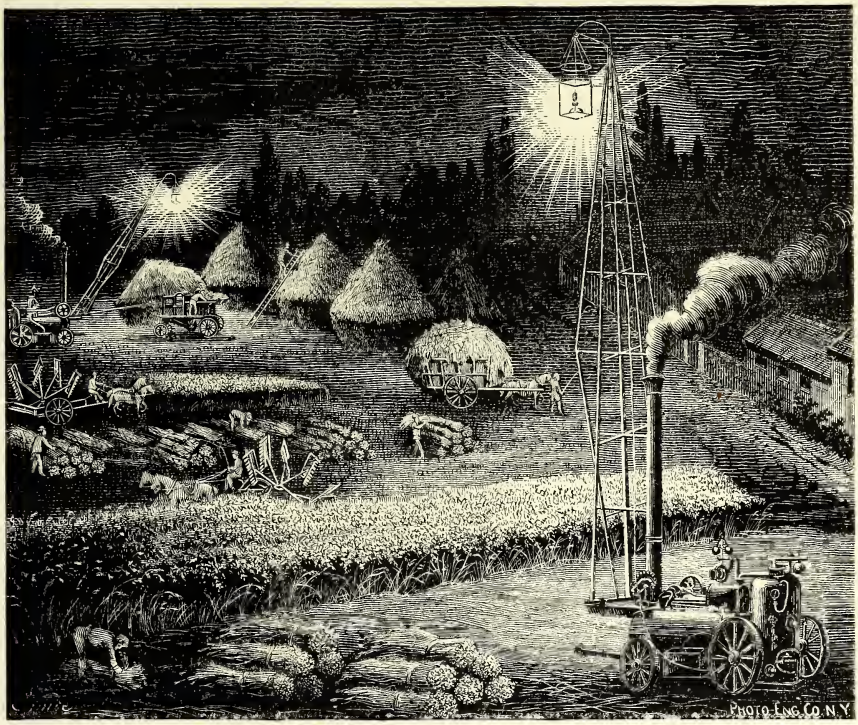


FIG. 253.—*Harvesting by the electric light (France).*

It consists of a Gramme machine and a mast for the elevation of the electric lantern, attached to an ordinary locomobile, which is also capable of doing the ordinary work of the farm, such as thrashing, etc., the mechanical connection of the engine proper with the Gramme machine being made or detached at will, so that for thrashing the locomobile may drive the machine and also illuminate the field.

Description.

The locomobile is on the usual horizontal system, with tubular boiler, and the one exhibited was of 4 nominal

Electric light in agriculture.

horse-power, but is capable of working up to a much higher force.

The Gramme machine is placed underneath the boiler and behind (relatively to the position of the engine) the fire-box, on a plate of iron bolted to the boiler. It is driven by a belt-pulley on a shaft driven by the engine.

Description of the Albaret apparatus.

The mast rises from the smoke-stack end of the engine, having an articulation to an additional bed-plate fastened to the engine frame, and is raised and lowered by means of a chain-wheel and pulley, worked by a crank. The locomobile carrying the whole apparatus is readily moved by its own power from place to place, and requires no special arrangement on arriving at the scene of its work.

The mast is 13 meters high, and is made of socketed tubes with cross-stays and jointed tension-rods, which allow the whole to be taken to pieces for transportation. The foot of the mast is mounted on a horizontal axis, on which it turns when elevating or depressing the lantern at its summit. The lantern is suspended by pulleys and a rope, which contains the insulated cord leading to the Jablochkoff light.

Cost.

The whole apparatus costs 6,000 fr., 4,000 fr. for the locomobile and 2,000 fr. for the Gramme apparatus, regulator, light, and mast.

Ensilage of maize.

This is a French invention, and may very properly retain its French name. *Ensilage* means to pack down in a trench or pit (*silo*).

French silos.

The French *silos* were shown by model in the Agricultural Annex of the Paris Exposition, on the Quai d'Orsay.

Auguste Goffart.

The system is the invention of M. Auguste Goffart, of Burtin, in Sologne, which old province of France embraces a part of the plateau of the Upper Loire, and is now included in the departments of *Loir-et-Cher* and *Loiret*, in France.

Particularly applicable to preservation of green corn-fodder.

Although other green crops besides maize are capable of being similarly preserved with advantage, it is more particularly in regard to green corn-fodder that the system has been applied in our country. In Europe, where economic processes are more carefully followed, apple pomace, turnips, cabbages, leaves seasoned with celery, grape leaves, leaves of beet roots, and pulp of beets from sugar factories have been preserved in pits, some of them from time immemorial, for feeding cows and goats. Necessity has so long compelled the efforts of human beings that we may find precedents in almost every line of improvement; but all experienced men who know the great difference that separates a happy suggestion, or even a successful attempt, from a practice well enough confirmed to become the base of a regular business, will admit that these precedents do not destroy the merit of any man who, like M. Auguste Goffart, has accomplished a continued and practical success.

M. Goffart's account of the advantages of green feed in winter.

The object cannot probably be better stated than in M. Goffart's own words, which are here given:

"*Advantages to be derived from the preservation of green fodder by ensilage over the method of preservation by drying.*—If there be one fact recognized by all agriculturists, it is that a certain quantity of grass, which, consumed in a green state, represents an ascertained nutritive value, loses a considerable portion of that value in passing into the state of hay intended for the winter sustenance of animals.

"The cow, which gives us in summer, while feeding on green grass, such excellent milk, and butter of such agreeable color and flavor, furnishes us in winter, when she eats the same grass converted into hay, an inferior quality of milk, and pale, insipid butter. What modifications has this grass undergone in changing to hay? These modifications are numerous. It is sufficient to cross a meadow at the time when the new-mown grass is undergoing desiccation in order to recognize that it is losing an enormous quantity of its substance, that ex-

Ensilage of maize.

hales in the air in agreeable odors, but which, if they remained in the plant, would serve as a condiment, facilitating digestion and assimilation.

M. Goffart's account.

"All stock-raisers, those of Sologne especially, know how rapidly our young cattle increase in weight in summer on green pasture, which, converted into hay and devoted to their nourishment in winter, scarcely keeps them in *statu quo;* hay given judiciously does not always prevent them from becoming lean.

Loss of value of grass in drying.

"Therefore, the sole fact of desiccation accomplished by fine weather, in the best conditions, causes the loss of a considerable part of essential substance. This loss, added to the physical modifications which render mastication and digestion of the hay more difficult than of the grass, and consequently assimilation less complete, merits the most serious attention on the part of those who are interested in agricultural affairs.

Critical seasons in hay harvest.

"The losses which I have mentioned are far from being all that result from our method of transforming grass into hay.

"Rains, ofttimes prolonged, coming upon the harvest, the absence of sufficient heat in autumn, are powerful causes of deterioration of hay.

"What agriculturist has not seen a hundred times his hay, injured by rain, deprived of its richest and most assimilative elements? The rain prolonged, the hay is invaded by a species of nauseous rot, which disgusts cattle and causes formidable maladies when hunger forces them to eat it. If these things occur to the common fodder crops—clover, lucern, sainfoin, etc.—what would happen to the fodder crops of high growth and great yield, such as maize and sorgho? Never in our temperate climate could we obtain for these a sufficient desiccation by the sun."

Difficulty of curing fodder crops in France.

It may be as well to state that the reasoning on this subject, the comparison of the values of green corn-fodder with lucern, sainfoin, and other green crops, and the value of or necessity for additional farinaceous or other food, together with calculations and general directions as to the quantity and mode of feeding, may be found in the translation of M. Goffart's work on this subject made by Mr. J. B. Brown, and procurable at 55 Beekman street, New York City.

Translation of Goffart's work by J. B. Brown.

Mr. Brown has been very active in the dissemination of information on this subject, and as his work is procurable in English the writer is spared the necessity of dwelling upon many points of interest which it might be well to embody in this report were the information only procurable in France and in the French language.

Goffart's experiments.

Experiments of M. Goffart.

The key to success in the construction of *silos* for the preservation of green-fodder crops is found in the absolute exclusion of air and exterior moisture. The expensive experiments and the preliminary failures of M. Goffart during

a period of twenty-five years were in consequence of a want of knowledge of the necessity for this hermetical treatment, and subsequently in devising means to secure it. *Ensilage of maize.*

He has not scrupled to speak of his efforts, either abortive or only partially successful.

The summing up of this part of his experience is instructive.

Having built *silos* hollowed in the ground, plastered with Portland cement, and perfectly water-tight— Goffart's experiments.

"I cut at that time my maize in pieces of three to four centimeters [1.17″ to 1.56″] long, I mixed a certain proportion of short straw (always too much), and I filled successively my *silos* by pressing down the layers of the mixture by one and sometimes several persons treading upon it. After this pressing down with great pains, I placed on the top a layer of short straw about ten centimeters [4″] long, and above all a layer of loam, beaten with care, in order to prevent all contact between the ensilaged maize and the air outside. During the following days I stopped up the fissures which appeared on the surface. When I proceeded, several weeks later, to open the *silo*, I found invariably a vacuum of several centimeters between the maize and the superincumbent clay. Notwithstanding the force of the compression that was produced during the ensilage, the maize had undergone another settling, and its upper part presented an alteration which would communicate rapidly to the lower layers. In order to avoid this result I had no other means than to feed it out as quickly as possible. Later I abandoned the clay as a covering for my *silos*. Immediately after having pressed in my mixture of cut maize and straw I applied above all a covering of plank, fitting exactly the opening of the *silo* and descending with the maize as it shrunk down. This simple change produced a perceptible amendment, but it was quite insufficient still. The alteration was but little retarded, but I was on the right track. To-day I still use the same *silos*, and I obtain a preservation indefinite and complete. In what, then, have I modified my processes? Instead of cutting my maize in pieces of three or four centimeters in length, I cut them one centimeter [$\frac{4}{10}$″] only. Instead of mixing a quarter and sometimes a third in weight of short straw, I never exceed the proportion of one-tenth, and oftener I bury the maize without any mixture. Finally, and here is the principal difference, I pile on the cover of my *silo*, when it is filled, four or five hundred kilos [800 to 1,100 lbs.] of stones or blocks of wood per square meter [$1\frac{1}{5}$ square yards] of surface. By my first processes I obtained only a temporary and incomplete preservation; with my last I obtained a preservation indefinite and absolute."

Cutting the corn.

Packing in the silo.

Covering with packed earth.

Substitution of plank for earth.

Cutting to a shorter length.

Weighting the planks.

* * * * *

"Cut in disks of only one centimeter thick the maize packs better in the *silo*, it occupies less space, and takes the form and consistency of a species of pulp, leaving in its mass the least possible amount of air. In proportion as the length is increased the preservation becomes less perfect, and finishes by being entirely defective."

The heavy weight is for the purpose of packing the mass and thereby expelling the air inclosed between the disks of stalk and in the cells, the air finding its outlet between the Advantage of heavy pressure.

Ensilage of maize.

joints of the covering plank. After putting in the *silo*, the crispness and elasticity of the stuff diminishes and its compressibility increases. The weighted cover follows the stuff in its softened condition, and brings it to that density which is necessary in order to put it out of the reach of all alteration.

Culture of corn for ensilage.

Culture of maize for ensilage.

It will be useful in this connection to cull a leaf from M. Goffart's experience in regard to the culture of the maize, its value when preserved in its succulent condition in *silos*, and its capacity for the occupation of the same ground indefinitely, not only without injury, but actually giving a surplus of manure applicable to other areas of cultivation:

Goffart's account of his experiments in culture of corn.

"At Burtin my soil possesses some qualities very favorable for this culture, but for four years my processes left much to be desired, and within two years I have made more progress than I had obtained during twenty years preceding. The large quantity of maize that the increase of this culture and my perfected processes have placed every year at my disposal has permitted me to double the number of my stock; and each animal produces triple the amount of available manure. Therefore, if my maize requires abundant manuring, it causes a

Increase of available manure.

production of manure more than sufficient. In fact, a hectare [2.47 acres] of maize, properly treated and successfully preserved, yields a product of more than 50,000 kilos of manure, and absorbs hardly one-third of this quantity. It is necessary to add that each week I spread upon my dung-heaps 100 kilos [225 lbs.] of phosphate. This practice gives excellent results, above all in Sologne, where our soil, naturally very poor in phosphoric acid, requires that we should furnish it in every possible form. Some foreboding people predicted four years ago that I would lose all my stock if I continued to feed them exclusively on maize throughout the year. I have continued to do so, and all my

Health of the cattle.

animals enjoy excellent health, without even a shadow of a malady. One of the most valuable properties of maize is the power of self-succession almost indefinite. Some of my finest maize occupies a field which, during the past eighteen years, has borne fourteen harvests of that plant without giving any signs of weariness; on the contrary, the later yield is better than the former. All the requirement is to give to the land suitable manuring, restoring each year the equivalent of that

Repetition of corn crops.

which is taken off. Potash is the predominating component of maize. Animals consuming it assimilate very little potash, and the dung-heap restores to the soil nearly all of it that has been removed in the crop. Another plant, much cultivated in Sologne, the hemp, possesses also the property of eternalizing itself upon the same field. Each farm has its hemp field, which, for centuries, occupies the same ground.

Adaptation of certain soils to the culture.

"The soil which is best adapted to the culture of maize is of medium consistency, rather light than heavy, moist without being wet, rich in alluvial matter, and therefore of a dark color. It is remarkable that our poor Sologne possesses an abundance of this kind of land, as if heaven had wished to give it some sort of compensation for all its other inferiorities. Heavy soil is equally well adapted to produce very fine maize, but requires more labor; for it is necessary to bring it to a state of fine pulverization, at the risk of the seed not sprouting, which is

always difficult in compact earth. In general terms, maize will succeed wherever beets do well, with the same conditions as to manuring and top-dressing. But maize cannot, of course, have the pretension to compete with advantage against such a rival; above all, in the rich countries where for so long a time it has been cultivated as a plant that is both valuable in commerce (sugar) and for fodder. In those parts maize can only make for itself a modest place, as a means of varying a little the food of our animals. *Ensilage of maize.* Goffart's account.

"But in those countries, such as the south of France and Algeria, where the excessive heat causes the beet to fail, there maize will render immense service. Preserved by ensilage, it will assure at all times to the cattle sufficient food, instead of those alternations of abundance and scarcity which often have such sorrowful results." Value of corn-fodder in south of France and Algiers.

After reciting his mode of flat culture in drills, he adds:

"Thanks to the care that I have specified, I obtain from my maize an enormous yield. In the past five years the minimum has been 75,000 kilos per hectare, and the maximum 415,000. The average yield has been 90,000 kilos per hectare."* Yield of green fodder.

Maize for ensilage should be drilled or planted in rows. That which is sown broadcast does not contain so much sugar as that which has more air and sun. It should be cut when it is in tassel, before it forms ears, and when it is the most juicy. If for any reason the cutting is deferred until the grain is partly formed, and a part of the leaves wither, or the frost touches it, it can still be preserved with great profit, but the air entering the shrunken cells of the partially dried stalk will cause it to sour more or less in the *silo*, and the cattle will not appreciate it so highly, though they will still eat it in preference to hay. If cut at the right time and preserved in the right manner, they always prefer it to June grass. The cutting can be done most economically with a reaper. Mode of planting. Period of cutting.

Construction of the silo.

Construction of the silo.

The form of the *silo* is very important, as it should offer the least possible resistance to the packing of the contents. All angles should be avoided; the elliptical is the preferable form.

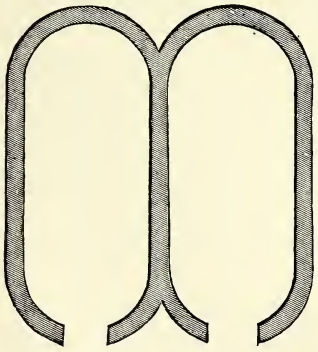


FIG. 254.—*Plan of twin silos. Auguste Goffart, Burtin, France.*

A *silo* should be as large as is compatible with easy and economical use; the preservation of ensilage is always less perfect in small *silos* than in large ones. Close to the walls there is generally some alteration in the quality, and it is desirable to reduce this as much as possible. Plan of silos.

* About 40 tons to the acre.

Ensilage of maize.

A *silo* may be built of grout, with 15″ walls; four parts sand and one part cement, mixed with coarse gravel, about half and half, laid on in plank boxes or troughs, and plas-

Construction of the silo.

tered inside with cement. The center wall, if built in pairs or triplets, should be 18″ thick; the walls vertical and built half underground for equability of temperature; the floor cemented.

Cost.

The cost of a *silo* is less per cubic contents for larger than for smaller sizes. For a moderate size an estimated cost of $1 per ton capacity is probably near the truth. The relative cost of brick, stone, grouting, lime, lumber, and labor will greatly vary the estimate. A *silo* 50′ x 12′ and 12′

Capacity of silos.

deep will have a capacity of nearly 150 tons, calculating 40 lbs. of pressed fodder to the cubic foot; but as it will not be full, owing to the subsidence of the material, the actual contents will be less. The careful trampling in layers day after day as the *silo* is gradually filled will insure its most complete filling.

Goffart's brick silos.

At M. Goffart's farm at Burtin the *silos* are sunk 2 meters * below the surface. The walls are raised 3 meters above the surface of the ground and are 5 meters wide; elliptical in plan. The walls are 2 bricks thick (about 18″) below the ground, and 1½ bricks thick above the surface. The walls and bottom are made perfectly water-proof with Portland cement.

Cost.

The triple *silos* cost 4,176 fr., and have a capacity of 812.45 cubic meters, about 5.14 fr. per cubic meter. The inventor intends raising the walls another meter. A roof excludes rain and snow. That shown in the view of "the *silos* of Burtin" is temporary.

Trench silo.

The *silo* may in some cases be a trench cut in the soil. The only kind of ground satisfactory for this purpose has

Francis Morris, Maryland.

clay above and a porous, dry soil beneath. Mr. Francis Morris, of Oakland Manor, Howard County, Md., makes trenches in a soil which has 12″ to 18″ of clay on top and a rotten rock below. The trenches are 5½′ deep, 7½′ wide at bottom, 11′ wide at top, and any length desired; the faces are not plastered. The angle of batter of the sides will depend upon the character of the soil and subsoil, and it is probable that but few soils could be trusted for a permanent *silo*.

It would certainly be better in most cases to revet the sides, to cement them, or, better than all, to build them of stone or brick, smoothly cemented inside, as elsewhere de-

* 1 meter = 39.37 inches.

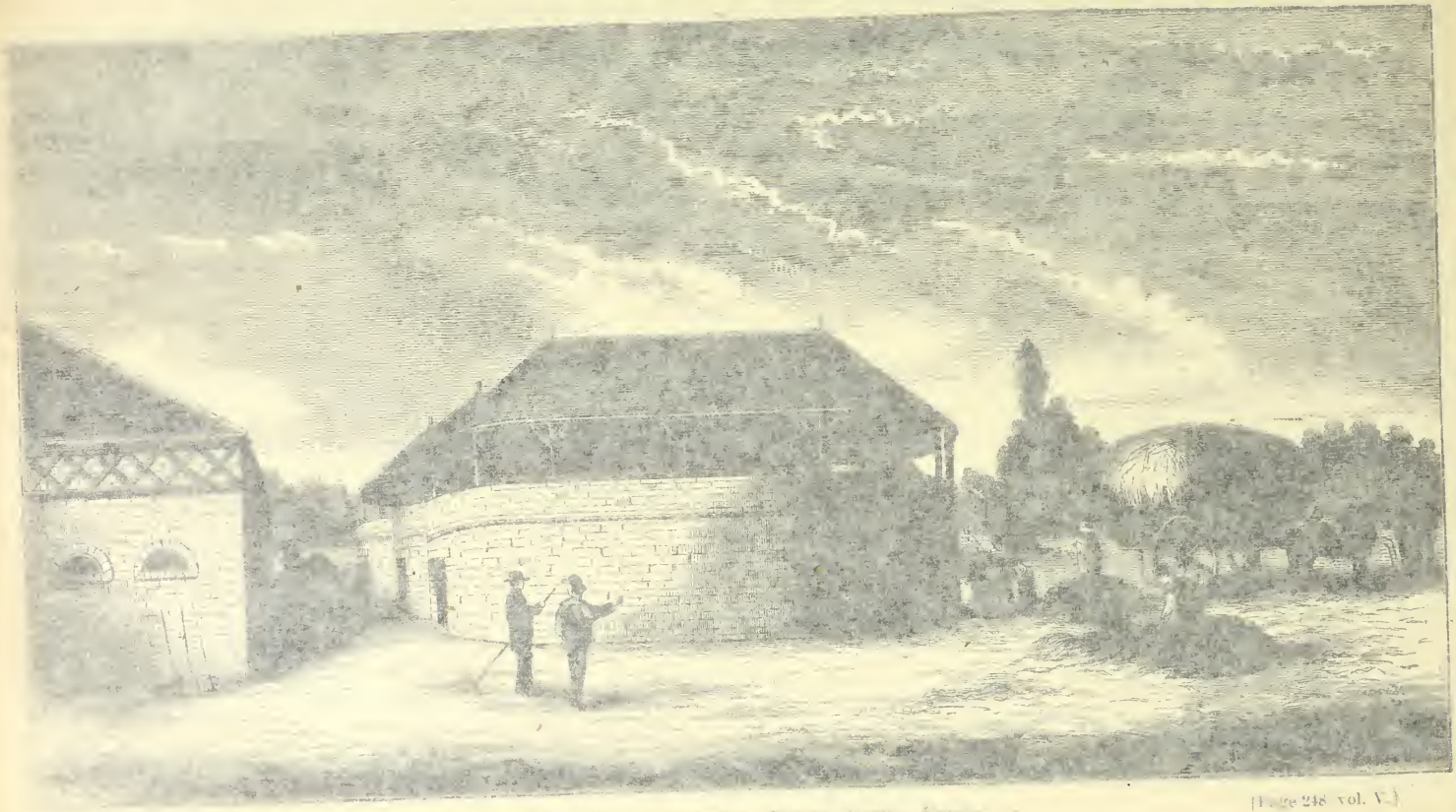


FIG. 925.—*The new silos of A. Gaffard, Berlin, France.*

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Ensilage of maize.

A *silo* may be built of grout, with 15″ walls; four parts sand and one part cement, mixed with coarse gravel, about half and half, laid on in plank boxes or troughs, and plastered inside with cement. The center wall, if built in pairs or triples, should be 18″ thick; the walls vertical and built half underground for equability of temperature; the floor cemented.

Construction of the silo.

Cost.

The cost of a *silo* is less per cubic contents for larger than for smaller sizes. For a moderate size an estimated cost of $1 per ton capacity is probably near the truth. The relative cost of brick, stone, grouting, lime, lumber, and labor will greatly vary the estimate. A *silo* 50′ x 12′ and 12′ deep will have a capacity of nearly 150 tons, calculating 40 lbs. of pressed fodder to the cubic foot; but as it will not be full, owing to the subsidence of the material, the actual contents will be less. The careful trampling in layers day after day as the *silo* is gradually filled will insure its most complete filling.

Capacity of silo.

Goffart's brick silos.

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Cost.

The triple silos cost 4,176 fr., and have a capacity of 812.45 cubic meters, about 5.14 fr. per cubic meter. The inventor intends raising the walls another meter. A roof excludes rain and snow. That shown in the view of "the *silos* of Burtin" is temporary.

French silos.

The silo may in some cases be a trench cut in the soil. The only kind of ground satisfactory for this purpose has clay above and a porous, dry soil beneath. Mr. Francis Morris, of Oakland Manor, Howard County, Md., makes trenches in a soil which has 18″ to 36″ of clay on top and a rotten rock below. The trenches are 5½′ deep, 7½′ wide at bottom, 11′ wide at top, and any length desired; the faces are not plastered. The angle of batter of the sides will depend upon the character of the soil and subsoil, and it is probable that but few soils could be trusted for a permanent *silo*.

Francis Morris, Maryland.

It would certainly be better in most cases to revet the sides, to cement them, or, better than all, to build them of stone or brick, smoothly cemented inside, as elsewhere de-

* 1 meter = 39.37 inches.

FIG. 225.—*The new silos of A. Goffart, Burtin, France.*

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scribed. No plan can be entertained which omits to prevent the percolation of water into the *silo*, and the slope of an earthen *silo* must be such as to remain firm and at the same time not so great as to prevent the superincumbent weight from compressing the mass effectually.

Ensilage of maize.

Construction of the silo.

In using an earthen trench, the sides are lined with straw, standing so that the ensilage will slip down; the bottom is floored with plank; the fodder is trampled in and heaped up above the surface of the ground; the top rounded up and covered with a thin layer of long straw, the thinner the better; above that are spread sheets of tarred roofing felt or paper, and above that earth piled on about 2′ deep. The earth must be pounded or rolled with a heavy roller, and this pressure must be repeated occasionally until the fodder settles.

French silos.

It is now Mr. Morris's intention to make a number of trenches radiating from a center, upon which the cutting machinery will stand and thus obviate the necessity of moving his machinery in filling a number of *silos*. One now upon the ground is 80′ long.

Cutting and ensilaging.

Cutting and ensilaging.

The French machine used for cutting the maize costs 800 fr., and will cut from 100,000 to 120,000 kilos (say from 11 to 13 tons) per day with an 8-horse-power steam-engine. Length of cut, $\frac{4}{10}$ of an inch.

French cutting machine.

In this country an ensilage-cutter is made specially for the purpose by the New York Plow Company, 55 Beekman street, New York City. Its capacity is from 4 to 5 tons per hour of green corn-stalks, cut to the length of $\frac{42}{100}$ of an inch, when run by a 2-horse-power engine, or 10 tons per hour with 4-horse power and a large machine.

American cutting machine.

The machine will take, in the latter case, five or six men to feed it from the heaps of maize brought fresh from the field, and the cutter should be set as high as the top of the *silo*, into the middle of which it will discharge by an apron, when the cut fodder can be raked and pushed towards each end. If it be inconvenient to place the cutting machine so high, an elevator can be attached to the rear of the machine to discharge into the middle of the *silo*. Four men will be kept busy spreading the cut fodder evenly and trampling it.

Capacity.

The calculation for dimensions is a cubic foot to 40 lbs. of cut green fodder when settled. The green fodder should be fresh from the field, not being laid in heaps to heat over night. Twenty inches of added depth of cut fodder per day

Calculation of dimensions and contents.

Ensilage of maize.

will keep sufficiently ahead of the heating, and by filling in with successively trampled layers the final subsidence will be less.

Corn should be cut fine.

In any *silo* the cut fodder should be fine enough to pack closely; the finer it is cut the better the preservation, and the less labor of mastication for the animals that eat it.

Filling and packing the silo.

The *silo* should be filled as rapidly as possible and the layer of cut fodder be kept level all the time, and the greater the compression the more perfect will be the preservation. It should be especially well packed along the walls. When filled to the top and carefully leveled, a layer of straw cut 2″ or 3″ long should (according to the French direc-

Cover of plank.

tions) be spread upon it, and on the top straight-edged transverse boards, fitting closely together.

The layer of straw has been omitted in America with good results, and a cover used made of battened shutters of two-inch plank, tongued and grooved, and in five-feet sections, the length a little shorter than the width of the *silo*, so as to allow them to slip down safely as the fodder subsides. The air escapes above through the interstices between and around the sections of the cover.

The weight on top is essential.

Mode of arranging the plank cover.

The boards or sections are arranged *across* the *silo* in order that they may be removed one by one when feeding out the ensilage, which is cut down vertically. The stones or wooden blocks are so disposed that they may be removed in the order of the displacement of the boards. One hun-

Requisite weight.

dred pounds per square foot is considered necessary. Salt may be added to the ensilage as the filling progresses, say 1 kilo to a cubic meter, which is about $\frac{1}{400}$ part of the weight of the ensilage. The weight of the latter when

Emptying the silo.

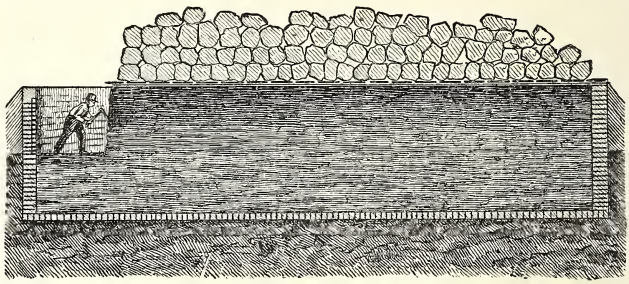


Fig. 256.—*Emptying a silo by vertical slicing.*

packed averages about 812 kilos per cubic meter. Approximately, this may be called 2 lbs. of salt to the cubic yard.

The door of the *silo* is recommended to be of temporary masonry, plastered in; the whole covered with a roof set

a little above the walls, so as to allow circulation of air beneath it, and the eaves extending beyond the walls to keep out the driving rain and snow. *Ensilage of maize.*

When the *silo* is opened, one of the shutters above the fodder is removed and the feed spaded out, the face of the stuff being cut down with a hay-knife. It is sufficiently dense to stand like a wall, and the daily consumption will keep pace with the effect of the air upon the face. If it is to remain till hot weather, it is better to take out the upper half first, leaving that which is below for summer use under the same cover of plank, which will not need to be heavily weighted. Emptying the silo.

Feeding of ensilage. Feeding ensilage.

The exposure of the ensilage to the atmosphere for a few hours before feeding induces a moderate alcoholic fermentation and is found beneficial, making the somewhat insipid mass more savory. The time must depend upon the temperature. No rule can be given applicable to the frosty days of winter and the fervid temperature of summer.

Speaking in a general way, and subject to conditions of temperature and exposure which may require a variation in the management, it may be said that ensilage should be taken from the *silo* the evening before it is fed, in order that it may have fifteen hours to become alcoholic; at that time it will become quite warm and the cattle will eat it greedily. Eight hours later it will have passed the proper limits and will rapidly spoil as food; 48 hours is its extreme duration when removed from the pit. This first fermentation increases the facility of digestion, and therefore the nutritive power of the food. Temporary exposure to the air.

A report from Winning Farm, Mass., dated December, 1879, gives the following comparison of the methods of feeding with and without ensilage: Winning Farm, Mass.

"Cost of keeping 30 head cows and 100 sheep per day:

1,350 lbs. ensilage, at $2 per ton	$1	35
90 lbs. shorts, at $18 per ton		80
50 lbs. hay, at $15 per ton		37
	2	52

Comparison of cattle feeding, with ensilage,

"Without ensilage, the cost was as follows per day:

800 lbs. hay, at $15 per ton	6	00
160 lbs. shorts, at $18 per ton	1	44
	7	44

and without it.

Balance in favor of ensilage	4	92

Ensilage of maize.

"If we count 100 sheep as 10 cows, the average cost per cow is 6¼ cents per day.

Advantage of ensilage in dairy farming.

"Since they were fed on ensilage the cattle are gaining; the milk increased 25 per cent. in one week. The butter is yellow without any artificial coloring. The stock will all leave the best of hay to feed on ensilage. Here is the weekly account of six cows that came in last March: They are fed 1,800 lbs. ensilage and 90 lbs. shorts per week; cost, $2.70; result, 22 lbs. butter, at 35 cents, and 240 lbs. skim milk, at 1 cent, $10.10; profit one week, $7.40 on 6 cows that without ensilage would have been dry."

Mr. Goffart writes:

Goffart's experience in feeding.

"I opened in April, 1877, my last elliptic *silo*, which contained nearly 100,000 kilos of maize, ensilaged in October, 1876, more than seven months. It disclosed a very compact mass of a brownish-green color; the temperature did not exceed 10 degrees (Réaumur) [54 Fahr.]; there was no appreciable odor; taken in the mouth it was really insipid, and this freedom from odor and taste produced at first an almost disagreeable sensation.

"I detached from the mass several hundred kilos, intended for the next feeding of my animals. It was hardly exposed to the air when it underwent a veritable change; the brownish color became sensibly green, the beginning of alcoholic fermentation took place, without exceeding the limits which that fermentation ought never to pass. That *silo* was not completely exhausted until the 10th of August, and the maize remained in good condition until the last day. My forty days' maize reached at that time the point where it was suitable to be cut for fodder; it had attained its full height, and in the month of August my animals ate it green; they were only ten days without maize during the year 1877.

"My *silos* of rye will be consumed during the winter. I do not need to say that green rye is much richer than maize, and a much smaller quantity will go as far; the mixture of these two kinds of fodder is an excellent diet."

And later, under date of Burtin, July 20, 1879:

"I am now feeding 63 head of cattle exclusively on ensilage of October last; it is as good as when first put up.

" * * * One important point that a long practice has put for me beyond doubt is that the same green maize nourishes better, the weight being equal, when it is cut short than when it is fed whole, and that its nutritive power increases when it has been softened by lying several weeks in a *silo*, then undergoing a light commencement of alcoholic fermentation a few hours before being fed out. I estimate that with young animals acclimated the increase of weight, at 80 centimes per kilo [7 cents per pound], will pay upon an average about 20 fr. per thousand kilos of preserved maize [about $3.50 per ton]. I consider this price as so nearly regular that I adopt it as a point of departure when I wish to reckon up my farming operations."

Address of J. B. Brown, American Dairyman's Association.

In a late address before the American Dairymen's Association, at Syracuse, N. Y., Mr. J. B. Brown states that—

"The farmers of Orange County require six acres for summer and winter support of one cow by hay and grazing, of which seven-twelfths is fed in a dry state. Twenty-five tons of green corn-stalks will sup-

port in better average condition two cows for a year, with 68 lbs. per day. But it is not difficult to double this quantity of stalks per acre. One-half the manure derived from feeding green fodder, carefully preserved, will keep up the land. A mature or fattening animal removes none of the constituents of its food that are valuable for manure. Therefore, the most fertile farms of the Eastern States are, as a rule, those that are devoted to stock or dairy farming. Cattle are not only the distributing reservoirs of vegetation, but they also may be made to increase the sources of supply. English agriculture became successful and profitable through stock farming."

Ensilage of maize.

Feeding.

Increased quantity of manure available.

The latest on the subject from M. Goffart is as follows, under the date of Burtin, December 17, 1879:

Goffart's experience, 1879.

"The longer experience that I have in feeding ensilage to stock, the more I am convinced of the great service that it will render to agriculture.

"From October, 1878, to October, 1879, I have fed the hundred animals in my stable exclusively with ensilage maize during the winter, and concurrently with fresh maize at the time when I had it. The animals have always enjoyed the most excellent health, and I can assure you that they have more appetite for the ensilaged maize than for fresh fodder, whatever kind it may be. Cows fed upon fresh maize give excellent milk, which yields first-quality butter and of exquisite flavor. Fed upon ensilaged maize, the milk is still very good, and I have not noticed that its quantity diminished, but the butter, while still being of good quality, is, however, inferior. But whatever may be the diet of the cows in winter, the butter made at that season is always inferior to that made during the fine weather. I have caused to be taken from the account-books of the expenses upon my domain the cost of the culture and ensilage of maize during the past season. You will observe the small cost for the food of the animals. Indeed, in reckoning 6 per cent. of the weight of the animal for its daily food, I arrive at an expense of $3\frac{3}{5}$ cents per day to feed an animal of 1,320 lbs. I know of no fodder of which the ration costs so little as my maize, which only costs me 90 cents per ton; and this notwithstanding the year has been unfavorable for maize, the wet spring and part of the summer having injured the plant. One could see at a glance in my fields that the stalks had not reached their normal heights, except in the middle of the beds, where they were high enough to escape injury by the wet. Besides, I was compelled to commence my operations too late, and the result was an increase of expenses in cutting and ensilaging in the shorter working day. Finally, the high price of wine this year has increased the cost of labor in a considerable degree. I was compelled to cut down the stalks by hand, but I ought to advise you of the great economy of cutting them with a mowing machine, as is practiced already by several of my disciples. * * * I have built near my silos an embankment, forming a platform, accessible from two sides by a gentle slope, for the easy ascent of carts loaded with maize. Upon this platform I have established an engine and my stalk-cutter, which are level with the upper part of my *silos*. The elevator carries the fodder over the center of the middle of one of the three *silos*, and it falls into all the *silos* in diverging streams. I have obtained thus a noteworthy economy, by avoiding moving the machines, and by saving valuable time at a season of the year when the working days are so short."

Milch cows.

Cost of feed per animal per diem.

Arrangement of cutting machine and silos.

Ensilage of maize.

It may be added that in France, although maize is largely grown for fodder, it does not mature its seed, which has to be imported, and the uncertainty of the sprouting of the seed is one of their principal difficulties, especially in wet and cool seasons.

Though the figures of expense in France are not applicable to the United States, it may be mentioned that the cost to M. Goffart of cutting the maize in the field, carting, cutting in the machine, and filling the *silos*, was 15 cents per 1,000 kilos=2,230 lbs.

Francis Morris, Howard Co., Md.

Mr. Francis Morris, of Oakland, Howard County, Md., has proved the value of the ensilage of corn in the years 1876–'77, stating in a letter of December, 1878, that the feed is relished by horses, mules, oxen, cows, sheep, and pigs. One of his later-built *silos* holds from 60 to 70 tons, in addition to his three original *silos*, each 10′ deep, 3′, wide, and 24′ long.

Mr. Bailey, Billerica, Mass.

Mr. Bailey has built at Billerica, Mass., two *silos* strictly upon the French plan: 40′ long, 18′ wide, and 12′ deep.

Mr. Thomas Hunter, of Lodore, Amelia County, Virginia, has also adopted the ensilaging of maize with success and profit.

Many will be ready to follow these enterprising leaders.

American agriculture.

The system of agriculture in the United States is essentially low, and necessarily so. Where land is cheap, labor dear, and capital limited, it is the true system and the only one which can succeed. High farming will come with changed conditions. Washington was right when he told Sir John Sinclair that the expensive systems of the English agriculturists would not pay in America. Neither will they yet over any large area of our country.

Low *vs.* high farming.

Washington's opinion.

The products of the low cultivation of the United States amounted in 1870 to $2,448,000,000 in grain, grass, cotton, tobacco, and cattle feed; the value of the animals slaughtered was $400,000,000.

United States agricultural production.

The raw productions of the American farms represent one-fifth of the capital invested, which is better than in France, where, according to M. Tisserand, the raw product is from one-sixth to one-seventh of the capital invested. The result in the United States is equal to $240 per head of the rural population, and near $1,200 for each adult employed in agricultural labor.

Relation of value of raw product to capital in France and in the United States.

The productive power of the American agricultural laborer is greater than that of the European. Under his system of low culture he has a larger profit than the farmers in the high-culture lands. The American farmer distributes his labor and expense over a relatively large area and harvests but little per acre; high-culture farmers concentrate their work and money upon a relatively narrower area and increase the yield per acre. Each system is right under certain conditions.

Productive power of the American laborer.

So long as the proportion of land in the United States to the agricultural population is nearly five times greater than that of France, it cannot be expected that the same systems of culture will suit both countries.

Proportion of land to agricultural population; United States and France.

Under low cultivation quantity rather than quality is sought, and the system runs through all departments of the rural interest. In live stock, for instance, the increase per cent. in the United States in 10 years, 1860–'70, was, in horses, 42, cattle, 39; and the United States possesses three times as many horses and twice as many cattle as France, though, curiously enough, the number of cattle relatively to the cultivated acreage is about the same—about 140 to the 1,000 acres. The uncultivated lands, however, of the United States maintain so large a portion of the cattle

American low system of agriculture.

Increase in live stock, 1860–'70.

Relative number of French and American live stock.

American agriculture.

that, to an acre, France probably maintains double the number of cattle. Relatively to the population, the number of animals per head is much greater in the United States than in France—over double the number of cattle, but few more sheep, nearly three times the number of horses, and six and one-half times the number of hogs.

Relation of domestic animals to population; United States and France.

Americans adapt their policy to their opportunity.

The people of the United States can generally be trusted to pursue the plan which secures most profit, and are quite as ready to change and to adopt new policy as is desirable. High culture is coming, and in many places has already been adopted with success. The great area of slovenly-tilled lands in the West reduces our average production, but the marvelous richness of our new lands realizes to-day the terse description:

"Tickle the land with a plow, and it laughs with a harvest."

Comparison of the methods of English and Spaniards in the settlement of the America.

The different procedure of our people and of the Spanish-American colonists shows two widely separated methods and results. While the Spanish devoted themselves to the feverish search for gold and silver, the English applied themselves to agriculture.

No one better understands and no one has better stated the matter than M. Eugène Tisserand, the Inspector-General of Agriculture of France:

Opinion of M. Eugène Tisserand, on the causes of the development of the United States.

"The presence of an enterprising race, sprung from a stock of austere men of severe habits, animated by a grand religious faith, gifted with great independence of character, attached to the soil and loving to cultivate it, determined above all to create in their new country a manly society after their own image—this is the main cause of the development of the United States. Their manners have changed since, their sentiments are more or less modified, but the basis of the character is still there. The granite foundation on which the edifice rests exists always, and insures its stability."

Acknowledgments to M. Eugène Tisserand.

Nothing could be more pleasant to the writer and nothing more appropriate to the subject of this report than to close with the words just quoted, those of M. Eugène Tisserand, to whose learning and practical skill in administration not alone are the people of France indebted, but also all foreigners who have had the pleasure of being associated with him, whether as members of the jury on agriculture, of which he was president, or as visitors to the admirable agricultural institutions of which he is the guiding spirit.

EDWARD H. KNIGHT,
Honorary Commissioner and Member of the International Jury, Class 76.

AGRICULTURAL PRODUCTS.

JOHN J. WOODMAN.

[Extract from the Official Classification.]

SEVENTH GROUP.—ALIMENTARY PRODUCTS.

CLASS 69.—CEREALS, FARINACEOUS PRODUCTS, AND PRODUCTS DERIVED FROM THEM.

Wheat, rye, barley, rice, maize, millet, and other cereals in grain and in flour.
Grain without husk, and groats.
Fecula from potatoes, rice, lentils, etc., gluten
Tapioca, sago, arrowroot, cassava, and other fecula, compound farinaceous products, etc.
Italian pastes, semolina, vermicelli, macaroni.
Alimentary preparations as substitutes for bread, home-made paste, etc.

CLASS 73.—VEGETABLES AND FRUIT.

Tubers: potatoes, etc.
Dry farinaceous vegetables: beans, lentils, etc.
Green vegetables for cooking: cabbages, etc.
Vegetable roots: carrots, turnips, etc.
Vegetables used for flavoring: onions, garlic, etc.
Salads, cucumbers, gourds; pumpkins, melons, etc.
Vegetables preserved by various processes.
Fresh fruit; dried and prepared fruits: prunes, figs, raisins, etc.
Fruits preserved without sugar.

REPORT

ON

AGRICULTURAL PRODUCTS.

Agricultural exhibitions.

In all civilized countries societies have been formed and fairs instituted for the advancement of agriculture, but in no other country have they been so generally established and useful as in the United States, and in no other country has agriculture assumed such importance and commanded such respect as in our own.

Importance of agriculture in the United Ststes.

The agricultural building at the Centennial.

At the Centennial Exhibition agriculture was placed on an equality, in every respect, with other interests, and a substantial building was erected, with ample accommodations, in which were placed side by side the agricultural exhibits of every nationality represented.

No special building for agriculture at Paris.

At the Paris Exposition no agricultural building was provided, nor was sufficient space assigned in the main exhibition buildings for foreign agricultural exhibits. Hence each of the principal nations competing was obliged to erect buildings of its own for this purpose, which were necessarily detached and unfavorably located for an international agricultural exhibition.

The short time for preparation limited the extent of our exhibit.

It is to be regretted that the agricultural products of the United States were not more fully represented. This is to be attributed to a want of means and time to collect and prepare samples of products for exhibition. It seems that the interests of agriculture, as well as the financial and commercial interests of the country, would have been promoted by placing on exhibition fair and well-arranged samples of all the products of our soil for which we are seeking markets abroad.

Exhibit of the Oregon State Commission.

Great credit is due to the Oregon State Commission for the full and most excellent samples of the agricultural products of that State. The "White Mammoth," "Chili Club," "Ninety-Day Spring," "White Velvet," and "Golden Amber" wheats were among the best, and unsurpassed by any other varieties on exhibition. The Commission did not wait for the action of Congress, but, in behalf of the agricultural interests of Oregon, proceeded to place its agricultural

Oregon wheat.

Oregon State exhibit.

products on exhibition where they might be examined. The benefits which must accrue to the State from this wise and timely action of the Commission must be great. Of the other great agricultural States of the Union some were not represented by their products at all in the Exposition, and others but partially so; hence Oregon fairly won among the food-purchasing nations of the Old World the reputation of being the foremost cereal-producing State in this Union.

Exhibit of corn.

Indian corn—which constitutes 60 per cent. of all the cereal products of this country, but the food value of which is not fully appreciated in Europe—was represented by a few good specimens; but the corn on exhibition was in such insufficient quantity that it attracted but slight attention, and did not fairly represent the real value of this great staple of the United States.

This criticism is due to the agricultural interests of the country and is not intended to reflect upon the action of any one having this department of the Exposition in charge. I am of the opinion that everything possible was done toward the collection of products with the limited means and time for the work. The requests made to the governors for samples of the products of their respective States fixed the time of shipment at so early a day as to render it difficult for them to respond, and in but few cases was there any apparent effort so to do.

Few responses made by States to the invitation to assist.

In such a country as the United States, extending through 30° of latitude and 60° of longitude, embracing within its vast domain more than two billions of acres of land, with every variety of soil and climate, and producing for export almost every kind of product, it requires time and means to collect samples of products so varied and so widely spread. The work cannot be done in a week or a month, and any attempt to make such a collection without adequate means must still be a failure.

Time required to obtain a proper exhibit from so vast a region and so varied a production.

Restricted purpose of this report.

It is not my purpose in this report to mention each meritorious exhibit separately, but to briefly refer to the kind and quality of the products on exhibition, and give such information relating to their cultivation, yield, and general use in the several countries as I have been able to obtain. Cereals and other farm products were exhibited by all the nations of Europe except the German Empire. Canada and the countries of Australia were well represented.

FRANCE.

The following were among the choicest products exhibited by France:

CEREALS.

Exhibits of wheat.

Chictam wheat.—This is a superior variety of winter wheat, extensively cultivated in France. The straw is 5′ high, and heads from 4″ to 5″ long. The exhibitor claimed to have raised 78 bushels to the acre.

English red (winter wheat).—This variety is a medium grower; fine large smooth heads and red chaff.

Kent wheat.—The samples on exhibition were very fine, with white straw and medium smooth heads. The kernel is bright, but is ranked among the red varieties.

Noah's wheat.—A beautiful variety of red winter wheat, said to be the best produced in France for bread-making. It is a rank grower; the straw and chaff white; the kernel hard and flinty.

White Bourges wheat.—Imported from Belgium, and highly prized by the French farmers; said to yield 50 bushels per acre, with proper cultivation.

Hybridized Burges.—A rank grower; white chaff and said to yield well.

Kissingland wheat (red winter wheat).—A rank grower; smooth white heads; a choice variety.

Varieties of wheat.

Golden Drop wheat (red wheat).—This variety is highly prized. The grain is very plump and hard; straw medium, with smooth heads and red chaff. Exhibitor claims to have produced 75 bushels per acre.

Prince Albert wheat.—A very white, choice quality; medium straw, with large, finely formed, smooth heads and red chaff.

Rousseau wheat.—Red winter variety; of excellent quality, with fine, large, beardless heads.

Victoria wheat.—A good quality of red wheat; hard, flinty kernels; rank grower; bright straw and red chaff.

Hallet wheat.—The kernel of this variety is dark and soft; a rank grower and yields well, but not a desirable variety.

Brunswick wheat.—A good quality of red wheat; rather soft, but yields well.

Hybrid wheat.—An excellent quality of white wheat; straw white and coarse; heads short, beardless, and well filled; white chaff; shells easily.

Thickset wheat.—A rank grower; white chaff, with well-filled, beardless heads.

FRANCE.

Exhibit of wheat.

Miracle wheat.—Fall wheat; plump, round, white kernel; very white, large straw of medium height; double heads and bearded. It is one of the oldest varieties known; is said to yield well, but easily degenerates.

White starch (spring) wheat.—It resembles rye very much in appearance, both the grain and straw.

Spanish wheat.—Large, rough, irregular-shaped kernel, medium straw, white chaff, and bearded heads.

Australian black winter wheat.—The grain is of a bright amber color; straw coarse; heads large and well formed; said to be very productive.

Varieties of wheat.

Nonette wheat.—A red-bearded variety imported from Switzerland; white, strong-growing straw, with heavy, drooping heads.

Black spring wheat.—This variety takes its name from the chaff, which is nearly black, with long beards. The grain is white and of fair quality.

Oats.

Oats.

Although oats constitute 28 per cent. of the cereal products of the country, but few varieties were on exhibition, and but one new or different from what is grown in the United States. That is called the—

Prunier oats.—This was propagated by Alexander Prunier, of Franconville, who is now engaged in growing and disseminating it for seed. It is a very strong grower, coarse, stiff straw, not liable to lodge or fall by wind. The grain is dark or black, and resembles the Norway oats.

The common white and black oats are generally raised. The white Hungarian oats are highly prized.

Rye.

Rye.

Some very fine samples of winter rye were among the exhibits. It is extensively grown for soiling. Rye constitutes but $10\frac{1}{2}$ per cent. of the cereal products of the country.

Barley.

Barley.

Barley is not extensively grown, and constitutes but 8 per cent. of the cereal products. The choicest varieties on exhibition were the "Celestial" (from Italy), the "Six Rowed," and the Hungarian, all fine samples.

Celestial barley.—This is considered a very choice variety for strong, heavy soils. The grain is very large and heavy, and almost as free from hull as wheat or rye. The straw is short, the heads of medium length, well filled, and bearded.

Millet.

Millet.

Samples of several varieties were among the exhibits, all good. This crop does not seem to be highly prized by the French farmers, and constitutes but 3 per cent. of the cereal products. It is said to be very exhausting to the soil. The kind most commonly grown is the "white millet." The heads are heavy and the seed white.

Corn (maize).

Maize.

Some small and inferior samples of corn were among the French exhibits. It is cultivated to some extent in the south of France, but in the middle and north is principally used by cutting up while green and feeding it to stock. The grain does not mature except in the south of France, and even there it is only small varieties which ripen. Corn is largely used for horse feed in the cities, but is imported from the United States. But little is known of its real value for the table. Could the French people become acquainted with the rich and delicious New England "rye and Indian brown loaf," or the "corn cakes" and "Indian puddings" so common in the United States, a still greater demand would be created for this most valuable product of our country.

Used green for stock principally.

Little known of its value for the table.

LEGUMINOUS PLANTS.

Leguminous plants.

Pease.

Pease.

Pease are extensively cultivated, and are used both for the table and feeding to stock. The vines of some varieties, if cut early and properly cured, make excellent fodder for stock, and the pease are valuable for fattening swine. They are also mixed with oats or rye and ground for horses and cattle. The following were among the choicest varieties on exhibition:

Purple-podded pea.—This is a new and valuable kind lately introduced into France. It is a rank grower and yields well.

Hungarian pea.—Large, white, and round; highly prized and extensively grown.

Varieties of pease.

Belgian pea.—Large and round, with a rich cream color; medium vines and produces well.

Black Hungarian, a pea-vine.—This is a small black pea, with fine running vines, thickly covered with leaves. The vines make choice hay for sheep, and the pease are valuable for stock feeding. This pea-vine is extensively grown in many countries in Europe.

Beans.

Beans.

Beans, like almost every other species of leguminous plants, are grown in France. The large black "horse-bean" is raised for horses and other stock. Samples of all the different varieties were among the agricultural products.

OTHER FOOD PRODUCTS.

Tubers, vegetables, nuts.

Potatoes and other root products, vegetables, chestnuts, etc., were among the exhibits. In 1873 these different cultures occupied a total surface of 1,981,424 hectares (about 4,953,560 acres), or 3.8 per cent of the territory under cultivation.

Oleaginous plants.

OLEAGINOUS PLANTS.

These cultures, consisting of colza, cameline, poppy and rape seed, hemp and linseed, olives, etc., constituted an interesting feature of the collection. In 1873 these cultures occupied 872,678 hectares (2,181,694 acres).

Textile plants.

TEXTILE PLANTS.

There were under cultivation, in 1873, 237,000 acres of hemp and 220,000 acres of flax. Both crops are considered profitable, and the plants and products of the same were on exhibition.

OTHER CULTURES.

Beets, hops, tobacco.

In 1873 there were 632,500 acres in sugar beets, 8,750 acres in hops, and 37,500 acres in tobacco. It is estimated that the cultivation of the sugar-beet has increased fivefold since 1840, and doubled since 1862.

Grasses.

GRASSES.

The following were the most valuable grasses on exhibition:

Sweet-scented vernal grass (*Anthoxanthum odoratum*).—Sweet-smelling hay; fine medium straw, with heads resembling beardless rye. It is quite extensively grown for both mowing and grazing, always mixed with other grasses.

Oat grass (*Trititum flavescens*).—Good for pastures, very productive, and can be grown on any soil.

Varieties of grasses.

Red-top (*Agrostis vulgaris*).—Adapted to moist land; makes excellent hay.

Creeping bent grass (*Agrostis stolonifera*).—Grows on moist land; excellent for forage and pasture.

Improved oat grass (*Arenatherium avernacum*, var).—Grows on all soils and is wonderfully vigorous and productive.

Broom or rescue grass (*Bromus Schraderi*).—Used for green forage in early spring.

Meadow fescue (*Festuca elatior*).—A strong, rank-growing grass; very productive, but requires a rich soil.

Barley grass (*Hordeum pratense*).—Excellent for pastures, but only found on rich land.

Meadow grass (*Poa pratensis*).—Grows on medium soil, is very nutritious, and not easily affected by drought.

Honey grass (*Holcus lanatis*).—Recommended for moist soil; very productive and nutritious.

Fox-tail meadow grass (*Alopecurus pratensis*).—Closely resembles timothy; principally grown for pastures and is very productive.

English rye grass (*Lolium perenne*).—Grows on all soils, makes durable pastures, and is very nutritious.

Hudson Bay grass (*Poa festiles*).—Grown for both hay and pasture; makes two crops of excellent hay in one season.

Red fescue (*Festuca rubra*).—Grows on all soils and makes durable pastures.

Sheep grass (*Festuca ovina*).—Considered valuable for poor soil; makes excellent, durable pasture.

Varieties of cultivated grasses.

Floating fescua (*Glyceria fluitans*).—Sea-grass; vegetates early; vigorous and quite nutritious; adapted to moist land.

Cock's-foot or orchard grass (*Dactylis glomerata*).—Grown for hay and pasture on all soils; very productive and good quality.

Couch grass (*Bromus pinnatus*).—Grown principally for pastures; resists drought on very thin, light soil; medium forage.

Canary or ribbon grass (*Phalaris arundinacea*).—Grows on low land; is coarse and vigorous; not valuable.

Hair grass (*Agrostis scabra*).—Medium for grazing; grows well on abandoned land, under trees, and in forests; resembles common June grass.

Timothy (*Phleum pratense*).—This is considered to be one of the most valuable of all grasses, not only in France but wherever it can be successfully grown.

Lucern.

Its character and value.

Lucern (*Medicago sativa*).—A species of clover with purple blossom, extensively grown in France and other portions of Europe for hay and fertilization. It is a strong, hardy plant, with large tap root, penetrating deep into the earth; hence a great renovator of the soil. Three crops of hay, equal in quality to that of common red clover, are frequently cut in one season. The cuttings are in June, August, and October. There seems to be no good reason why lucern cannot be more generally grown in many portions of the United States. The experiment is at least worth trying, and no time should be lost in solving this important problem.

FRANCE.

The following tables will show the amount of productive land in France, also the area, yield, and amount produced of the different cultures:

Division of productive land in 1873.

Division of productive land in 1873.

	Hectares.	Acres.
Cereals	16, 997, 000	42, 492, 500
Other cultures	1, 346, 000	3, 365, 000
Artificial meadows	3, 095, 000	7, 737, 500
Fallow ground	4, 863, 000	12, 157, 500
Land under cultivation	26, 301, 000	65, 752, 500
Natural meadows and orchards	4, 224, 000	10, 560, 000
Vineyards	2, 583, 000	6, 457, 500
Woods and forests	8, 357, 000	20, 892, 500
Other productive lands	15, 164, 000	37, 910, 000
Total of productive land, pastures not included	41, 465, 000	103, 662, 500

Area of agricultural lands of France.

The total agricultural territory of France at the present time, including all pastures and grazing lands, is estimated at 132,262,500 acres.

Area and amount of cereal products in 1873.

Area and amount of cereals, 1873.

	Hectares.	Acres.	Hectoliters.	Bushels.
Wheat	6, 966, 000	17, 415, 000	83, 861, 000	237, 696, 000
Oats	3, 182, 000	7, 955, 000	70, 493, 000	199, 730, 000
Rye	1, 913, 000	4, 782, 500	20, 779, 000	58, 874, 000
Barley	1, 117, 000	2, 792, 500	18, 733, 000	53, 075, 000
Mixture of wheat and rye	503, 000	1, 257, 500	6, 287, 000	17, 812, 000
Buckwheat	678, 000	1, 695, 000	9, 722, 000	27, 546, 000
Corn	606, 000	1, 515, 000	8, 918, 000	25, 269, 000
Total	14, 965, 000	37, 412, 500	218, 783, 000	619, 912, 000

Yield of cereals for an average year from 1869 *to* 1873.

Average yield of cereals per acre, 1869–1873.

	Hectoliters per hectare.	Bushels per acre.
Wheat	15	17
Oats	22. 1	25
Rye	13. 8	14. 82
Barley	18. 1	20. 4
Mixed wheat and rye	15. 4	17. 04
Buckwheat	16. 9	18. 2
Corn	16	18
Millet	13. 8	14. 82

Number of holdings, average size.

Relative numbers of proprietary and tenant cultivators.

The territory of France is divided into 3,977,781 farms, averaging about 16¼ acres of arable land, or 33¼ acres of what is termed "productive land," each. Of this number 2,826,388, or 71 per cent., are cultivated by the owners, and 831,943, or 21 per cent., are rented at a fixed cash rent, and less than 10 per cent. are let for a share of the crop, which is agreed upon between the proprietor and the farmer; the

farmer performing the labor and the proprietor furnishing buildings, a portion of the seed, stock, implements, etc.

Statistics of the number of implements.

In 1873 there were in the whole country 3,195,500 plows, of which only 860,572 were of improved make. There were 134,116 thrashing machines, of which 6,793 were worked by steam and 127,323 by horse-power, 3,161 mowers, and 2,833 reapers. This would give about 4 plows to 5 farms, or 1 plow to 20¼ acres of arable land, a little more than one thrashing machine to 33 farms, one mower to 1,258 farms, and one reaper to 1,408 farms. Thrashing machines are generally owned by the wealthy farmers and agricultural societies and let to the small farmers.

Relation of the number of implements to the number of farms.

Hand thrashing.

Much grain is thrashed by hand, a great deal by hand-driven machines; the work is done from time to time so as to have fresh straw for feed.

Number of working animals to the farm.

The same year there were in all France 4,817,198 horses, mules, asses, and oxen, or about 6 working animals to 5 farms, including horses and mares used for breeding. When the large number of horses used in the cities and in other industries are taken into account, it must be inferred that most of the farm work is done by human labor.

The land in France, how formerly held and at present.

Before the Revolution most of the real estate was held by the nobility and the church; but the Revolution changed this order of things, and many of the large estates were confiscated to the government and sold to the farmers in parcels suited to the means of the purchasers. A law was also enacted which provided that the real estate of deceased persons should descend to and be equally divided between all the heirs of the deceased. This division has been going on until many of these farms have been divided into very small parcels. In order to leave each proprietor's land in connection with a road or drive way, the estates have been divided into long narrow strips, some of them but a few feet wide. No fences are used and the plowing is down with reversible plows, so that the furrows are all turned one way, leaving the ground perfectly level. Some proprietors own several of these parcels; but, as a rule, the lines between farms are indicated by the growing crops.

Division of real property at demise of owner.

Small holdings.

Absence of fences.

Description of farm in neighborhood of Paris.

I visited a farm fifteen miles from the city of Paris which bore the reputation of being a model farm for that department of France (*Seine-et-Oise*). It contained 6 hectares or 15 acres of land, in 35 separate and detached parcels, all within less than one mile of the little village in which the residence of the proprietor was situated. On this farm were growing crops of wheat, oats, barley, potatoes, and other

FRANCE.

roots and vegetables, also vineyards, orchards, and meadows. About one-third of the entire farm was in wheat and oats.

Description of farm in neighborhood of Paris.

The team work was done with one horse and the labor by two men and two women.

Labor.

The men were paid about $11 per month and women one-half that amount, with board; 12 hours constitute a day's labor.

Manuring.

Most of the manure used upon the land is purchased in the city and hauled with one horse. The cost of manuring an acre of land, with the usual quantity (40 cart loads to the hectare), is about $40.

System of rotation.

The system of rotation of crops adopted on this farm is as follows:

1st year.—Potatoes or other roots, with stable or compost manure.
2d year.—Wheat, without manure.
3d year.—Oats, without manure.
4th year.—Beans, pease, or other vegetables, with manure.
5th year.—Wheat, without manure.

With this system of rotation and manuring the soil is made to produce heavy crops every year and at the same time increase in fertility. The proprietor states that his

Yield.

average yield of wheat is 60 bushels per acre, oats from 75 to 80, and barley about 30 bushels per acre.

Income.

His net income from his farm, after supporting his family, paying all expenses and taxes, amounts to about 2,000 fr. a year, or nearly $380.

Beet root farm and sugar factory.

There are some large farms in France on which improved implements and machinery are used. One visited in the north of France contained 100 hectares (250 acres) of land and a factory for the manufacture of sugar from beets. Yet this farm is in 50 detached pieces. Beets are cultivated and

Yield.

manufactured into sugar. The average yield per acre is

Wages.

from 2,000 to 2,500 lbs. The wages paid hands upon the farm in summer are 50 cents a day and in the factory in winter 70 cents a day, without board.

Rotation of crops.

The rotation of crops here is as follows:

1st year.—Beets, with stable or compost manure.
2d year.—Wheat, with guano or phosphates.
3d year.—Beets, with strong manure.
4th year.—Oats and rye mixed, with guano or phosphates.

Systematic fertilization.

No good farmer thinks of raising crops without the aid of fertilizers, and the production of manure is also systematized. Everything that comes from the field which is not used for food is carefully collected and placed upon the compost heap; and in estimating the value of an animal to be kept upon the farm, the amount of manure it will produce is taken into account.

The following table will show the number of domestic animals in 1873, and the amount of manure produced by them:

Number of domestic animals.

Manure product.

Animals.	Number of animals.	Average annual quantity produced by each animal.	Total annual production in pounds.
		Pounds.	*Pounds.*
Horses and mares	2,310,585	6,048	13,970,880,000
Colts and fillies	432,123	4,144	1,790,208,000
Asses	410,268	2,576	1,056,160,000
Mules	303,775	4,480	1,361,420,000
Bulls and oxen	2,105,651	6,720	14,152,320,000
Cows	5,938,818	6,508	39,244,912,000
Young cattle	2,424,513	3,248	7,876,400,000
Calves	1,252,477	1,680	2,103,360,000
Sheep	19,701,318	748	15,445,584,000
Lambs	6,233,796	330	2,094,624,000
Hogs	4,074,117	1,904	7,756,896,000
Sucking pigs	1,681,539	896	1,507,072,000
Goats	1,358,940	672	913,248,000
Kids	435,897	336	146,496,000
	48,663,817	.....	109,327,080,000

Relation of amount of manure product to acreage.

From the above it will be seen that the annual production of manure from all domestic animals in the nation would give about 1,663 lbs. per acre, or about one-sixth of the amount required for a triennial dressing of all the arable land. About five-sixths of the whole amount must be supplied from the compost heaps and the substitution of commercial manures, consisting principally of guano and phosphates.

ROTATION OF CROPS.

Rotation of crops.

French farmers have learned, by long and well-tried experience, that nothing is more exhausting to the soil than "repeated cropping" by the same product. Hence a systematic rotation of crops is recommended and practiced by all the best and most successful farmers, varying to suit the soil and climate. Three systems are in use—(1) the biennial, (2) the triennial, and (3) the quadrennial. In 36 departments the biennial system is practiced; in 46 departments the triennial; and in 5 departments the quadrennial has been adopted. A French agricultural writer says:

In the substitution of the more rational and progressive quadrennial system for the triennial, which has already been notably improved in two of the rotations, you avoid the succession of one cereal to another cereal. This favors the growth and maturity of the plant, and prevents the propagation of injurious weeds.

Triennial system.

The following is the improved triennial system:

1st year.—Wheat. Sometimes a small portion of the field is sown with rye.

2d year.—A portion of the field is sown in oats, and the balance planted in roots and leguminous plants.

3d year.—Trefoil follows oats, flax follows roots, and colza leguminous plants.

FRANCE.

In the department of *Seine-Inferieure* the rotations vary necessarily with the nature of the soil, but the triennial is most generally practiced.

Seine Valley. Systems of rotation varying with the soils.

In the communes of Quevilly and Sotteville, in the Seine Valley, where the soil is sandy and contains but 6 per cent. of clay, the rotation generally followed is the biennial, with one part placed outside the annual rotation and devoted to meadows and pastures of long duration. On these lands farmers are largely engaged in stock raising.

1st year.—Rye or barley, sometimes followed with buckwheat the same year.

2d year.—Beets and potatoes. One-third part of the land, out of the rotation, is in lucern.

These crops are ordinarily cultivated in the following proportions: Rye and barley, $\frac{3}{8}$; potatoes and beets, $\frac{3}{8}$; lucern, $\frac{2}{8}$.

In the same valley, where the soil contains 12 per cent. of clay, and is consequently more fertile, the rotation is triennial, with one part outside the rotation for lucern.

1st year.—Winter wheat.
2d year.—Fall rye.
3d year.—Potatoes, followed by lucern.

The proportion, of these crops are generally about as follows: Winter wheat, $\frac{1}{4}$; fall rye, $\frac{1}{4}$; potatoes, $\frac{1}{4}$; lucern, 8 years' duration, $\frac{1}{4}$.

On lands of a heavier soil, vegetables, especially beans, are raised the third year.

In the Bray country, where the soil contains but 7 per cent. of clay, the rotation is triennial, and the crops generally consist of rye, oats, and clover. The lucern does not grow well on these lands on account of an impervious layer of clay under the arable soil, which stops the development of the roots of the plant, and greatly diminishes its growth and duration. The rotation is—

1st year.—Rye.
2d year.—Oats.
3d year.—A part in clover, the balance in roots.

The rotation for the clay and calcareous soil of the Bray country is as follows:

1st year.—Wheat.
2d year.—Oats.
3d year.—One-half in clover and one-half in mixed grain.

Marling.

One part is left out of the rotation for meadows and pastures. Sometimes a portion is summer-fallowed and sown to wheat in the autumn. These lands are "marled" (manured with marl) once in 25 years. The amount used

varies from 600 to 3,000 hectoliters per hectare, an average of about 2,000 bushels to the acre. FRANCE.

MEAT PRODUCTS, 1873. Meat products.

The following table shows the average live weight of the animals slaughtered and the net weight of the dressed meat; also the amount of dressed meat to the 100 lbs. of live meat:

Relation of net to live weight.

Animals.	Live weight.	Net weight of the quarters.	Per cent. of meat to live weight.
	Pounds.	*Pounds.*	
Oxen and bulls	1,125	675	60
Cows	836	475½	57
Calves	153	99	65
Sheep	81	45	55
Lambs	27	18	67
Swine	67½	38¼	57
Kids	15¾	9	57

Number of animals and yield in meat.

The number of animals slaughtered, of all kinds, were 14,507,689, yielding 1,909,340,064 lbs. of meat, about 53 lbs. to each inhabitant. Of the meat product, about 55 per cent. was from bovine species; 31 per cent. swine; 13 per cent. ovine species; and 1 per cent. caprine species. The weight of dressed meat varies in the different species from 55 to 76 per cent. of the weight of the living animal. In all species the young furnish a larger percentage of meat to the gross weight than the full-grown animal.

MILK PRODUCTS. Milk products.

The estimated average annual amount of milk produced in the whole country is 80,500,000 hectoliters (1,771,000,000 gallons). The average amount from each cow is 16½ hectoliters, or about 269 gallons.

A mixed husbandry, thorough cultivation, and a systematic rotation of crops, with a liberal supply of fertilizers, seem to be the principal secret to success in French farming.

GREAT BRITAIN. GREAT BRITAIN.

The English agricultural exhibits consisted principally of root products, leguminous plants, grasses, and seeds. The cereals were not largely represented.

Wheat. Wheat.

Mold's wheat.

Samples of Mold's new varieties of wheat (white and red) in the straw, showing the products of a single grain, attracted much attention. The exhibitor claims that this wheat can be sown one month earlier than any other variety,

GREAT BRITAIN.

and takes but one-half the quantity of seed; that 105 grains have been produced from 1, and 14 quarters (112 bushels) from a single acre in one year—statements which seem to be somewhat extravagant.

Root crops.

Roots.

Roots for stock feeding are extensively cultivated throughout England. Some of the samples on exhibition are worthy of special mention.

Swedes.

French Swede turnip.—This turnip is said to have no superior when size, quality, symmetry, and yield are taken into consideration. It grows in all climates. If planted in May it will mature in October. Its color is ordinarily dark in warm climates and light in cold climates. It grows best on medium soil, not too heavy; is planted with a drill, in rows 18 inches apart, and the plants thinned to about 12 inches apart; and is said to yield from 25 to 30 tons to the acre. The samples on exhibition averaged about 17 lbs. each. The crop is gathered in November and put in small heaps, covered with straw and a little dirt, with an opening at the top for ventilation. They are principally used for feeding sheep, and, when mixed with oil-cake or cotton seed, are considered very valuable for fattening purposes.

Carrots.

Carrots.—Carrots are grown almost exclusively for horses. A deep, well-pulverized soil must be selected for the crop, and if it is a fine fertile loam handsome roots may be expected. The crop is gathered in October or early in November, the tops removed, and the roots stored in dry sand, where they are preserved for feeding.

Mangold-wurzel.

Mangold-wurzel.—There were several varieties of mangolds on exhibition, and some of enormous size and great beauty. Their principal use is for feeding to cattle. The "Yellow Globe Mangold" is said to be among the best and heaviest cropping varieties cultivated. It is remarkable for its immense size, beautiful shape, neat top, fine clear skin, and most excellent feeding properties. It succeeds well on all soils. It is claimed that 84 tons have been produced from one acre.

Varieties.

The "Improved Mammoth Long Red" is said to be the "heaviest cropping" and most nutritious of all long mangolds. It requires a deep mellow soil, and will yield from 40 to 50 tons to the acre.

The "Golden Tankard" is a yellow-fleshed variety, and a "heavy cropper." The yield is said to be from 55 to 60 tons to the acre, with good cultivation. For dairy cows it

is considered indispensable, as the milk from cows fed upon it will bring a higher price in the market than that from cows fed upon any other mangold. Root crops.

The "Yellow Intermediate mangold" is highly prized by many farmers. It has a neat top, with few leaves. The root is nearly as broad at the bottom as at the top, consequently is very heavy, averaging from 15 to 20 pounds each. Mangold-wurzel.

Onions.—The "Improved Reading," large "Red Early Italian," "James's Long-Keeping," and the "Queen" were among the best varieties exhibited. The "Queen" is a white-skinned variety, remarkable for quick growth and excellent keeping qualities. If sown early it will produce onions from 1 to 2 inches in diameter early in summer, which will keep until the following year. Onions.

Pease. Pease.

The "Emerald Gem" is a very early pea and very extensively grown. It is fit for the table in eight or ten weeks after planting. It grows from 3 to 3½ ft. high. The pease are valuable for swine and sheep.

The "Jewel" is a dwarf pea, grows about 18 in. high, and requires no sticks. The pods are thickly set and well filled.

The "Best of All" is a well-known variety, very prolific, has an excellent flavor, and is extensively raised.

Beans, hops, cabbage, cauliflower, kale, etc., were among the exhibits in endless profusion. Various vegetables.

Kale. Kale.

Some four years ago public attention was specially directed by the London Farmers' Club to the great value of kale as a spring crop for sheep, since which its cultivation has very largely increased. The plant somewhat resembles the cabbage, but does not form into one compact head. It grows to the height of from 2½ to 3 feet, the stem being thickly studded with side shoots forming various-sized heads, and producing an extraordinary quantity of valuable green food. The following is from a paper read before the London Farmers' Club: Spring crop for sheep.

"In April, towards the end of the month, we drilled in the thousand-headed kale seed, about 5 to 6 lbs. per acre, which is the best known and most desirable of any green crop I have ever seen. It is a plant that produces more feed per acre than any other, does not disagree with any stock, nor does it impoverish the land. With me it has never caused sheep or lambs to blow or scour. Eighteen perches per day, with a little straw, have kept 270 sheep for three months, without the loss of one." Mode of culture.

GREAT BRITAIN.

Agricultural holdings.

Agricultural holdings.

As a rule, the farmers do not own the soil they cultivate in England. Tenants with ample capital have no difficulty in obtaining a lease of land from fourteen to twenty-one years, with power of renewal for seven years longer if all the conditions of cultivation, which are minutely specified in the lease, have been faithfully complied with. The land is generally under the control of an agent. The arable land, as a rule, is under a high state of cultivation and very productive.

Great yield of cereals.

Although more than 50 per cent. of all the cultivated land is devoted to the production of wheat, rye, oats, and barley, and the average yield of these crops exceeds that of any other country in Europe, if not in the world, yet the

Price reduced by importation.

production of wheat is rendered unprofitable by the importation from other countries of wheat, which sometimes rates at a price in the market below the actual cost of production to the English farmer.

Cultivation.

Cultivation.

The general farm work seemed to be well systematized and all of the arable land well cultivated. The following is the rotation of crops recommended and practiced by the best and most successful farmers:

The four-year rotation of crops.

1st year.—Wheat.
2d year.—Roots.
3d year.—Barley, with a portion in seeds.
4th year.—Clover follows barley, and beans follow seeds.

The land is always highly manured for the root crop. Sometimes rye is sown in place of wheat and oats in place of seeds. In the latter case, the whole field is in clover the fourth year.

Agricultural statistics.

Agricultural statistics.

In 1873 the cereal products of Great Britain amounted to 320,840,000 bushels, or about 12 bushels to each inhabitant. Of this amount 33 per cent. was wheat, 38 per cent. oats, 29 per cent. barley, and 6 per cent. rye. The same year there were 2,101,100 horses, 6,002,100 cattle, 29,495,900 sheep, and 2,519,300 swine in the country.

Production of cereals.

Animals.

AUSTRIA-HUNGARY.

AUSTRIA-HUNGARY.

The Austrian agricultural section of the Exposition was well filled with creditable samples of wheat, rye, barley,

oats, millet and corn, rice, peas, beans, etc. There was also a fine collection of fibrous plants and their products; samples of raw, granulated, and crystallized sugar from beets; and of hops, olives, tobacco, and products of the vine.

Agricultural products.

Agricultural products.

The climate and soil are very favorable for agricultural operations. The soil is fertile, and 92½ per cent. of the whole territory is productive land. As there is no restriction to the right to acquire and own land, the farmers frequently own the soil they cultivate. Nearly all of the different methods of cultivation common to the other European countries are practiced in different parts of the empire, and nearly all of the cereals are cultivated. The average yield of wheat is about 15 bushels per acre, rye 15, barley 17, oats 19, corn 15, buckwheat 14, and millet 13½. This average is considerably below that of several other cereal-producing countries in Europe, which would seem to indicate poorer cultivation. Although the average amount of cereals produced is but 13½ bushels per inhabitant, yet in some years cereals are exported in considerable quantities. The average annual products for the whole empire are estimated at 595,000,000 bushels, as follows:

Percentage of productive land.

Average yield of cereals per acre.

Average production of cereals.

	Bushels.
Wheat	113,000,000
Rye	156,000,000
Barley	85,000,000
Oats	127,000,000
Corn	93,500,000
Millet	15,000,000

Distribution of crops.

Distribution of crops.

Grain.—The production of wheat and corn is largest in Hungary and Bohemia, that of rye in Bohemia. Oats are extensively cultivated in Hungary. Rice is only cultivated in the district of Gradisca.

Grain.

Potatoes.—The average yield of potatoes for Austria is 227,000,000 bushels, cultivated principally in Bohemia, Moravia, Silesia, Galicia, and Lower Austria. In Hungary the crop is about one-half that of Austria, or 113,500,000 bushels. All of the above countries produce large quantities of—

Potatoes.

Beets.—Sugar beets, from which sugar is manufactured; and the pulp used for feeding swine and cattle.

Beets.

Flax and hemp.—Flax and hemp are produced principally in Galicia and the north of Hungary.

Flax and hemp.

AUSTRIA-HUNGARY.

Distribution of crops.

Tobacco.

Tobacco.—The cultivation of tobacco, all over the empire, is under the control of the government. It is grown in Hungary, Galicia, Bukovina, and in the Tyrolean districts of Roveredo and Riva. The average annual production is 51,296,000 lbs.

Hops.

Hops.—Bohemia has thus far excelled all the other states in the cultivation of hops. The average annual production in the whole country is 6.496,000 lbs.

Olives.

Olives.—The olive is one of the staple products of Dalmatia, and the oil is largely exported, producing a large revenue. The annual production of oil amounts to 29,000,000 lbs.

Vineyards.

Vineyards.—The vineyards occupy 3,829 square miles and produce annually about 65,000,000 bushels.

Pea-fodder.

Pea-vines.—The pea-vine is generally cultivated for forage, and is considered very valuable.

Cultivation.

Cultivation.

Three-year rotation.

The system of culture most generally followed in the production of cereals is what is called the "three annual rotations." The arable land is divided into three parts, each part of which is alternately sown (1st) with winter wheat, (2d) with spring wheat, and (3d) is left fallow. Lately this system has been changed by many of the best farmers, the "dead fallow" dispensed with, and the land used for pastures and the production of forage. On the gravelly soil the "biennial rotation" is practiced, and one-half of the land remains every year fallow or produces only grass, while the other is sown. It is not uncommon, however, to find farmers who sow wheat several years in succession on the same ground, a practice universally condemned by scientific farmers.

Cereals, etc., produced in Hungary.

The Hungarian plains and parts of the mountainous country are well adapted to the cultivation of grain, especially wheat. In less fertile soil rye is cultivated. In the mountainous regions, where the climate is not too rigid, corn is successfully raised, and in the most elevated portions oats and barley.

In the mountainous countries, especially those of the north, potatoes and cereals constitute the principal food of the inhabitants. The cultivation of leguminous plants and common vegetables do not receive much attention.

Agricultural schools.

The government is doing much for the encouragement of agriculture and the dissemination of information relating to the different branches of farming. There are in Hungary 5 agricultural colleges and 3 primary agricultural schools.

Live stock.

Live stock.

Horses.—Much has been done for the improvement of the breed of horses by crossing with the English and Arabian races. Stallions are kept by the state at different depots for this purpose, over 1,600 being so maintained. Horses.

Cattle.—But little progress has been made in the improvement of cattle. Four-fifths of all the horned cattle are of the Hungarian race. Cattle.

Sheep.—Much attention has been given to the raising of sheep, and the wool produced constitutes one of the principal articles of export. The quality is superior. Swine.

Swine.—The raising of swine is also an important branch of agriculture, and large numbers are exported.

NORWAY.

The principal products of Norway are rye, oats, barley, wheat, peas, beans, and potatoes. The winters are unfavorable for winter wheat, consequently spring wheat is generally raised. Barley and oats are the staple crops. They are often sown together and called mixed grain. Staple products.

It takes from 110 to 120 days from the sowing for spring wheat and oats to grow and be ready for harvesting; barley about 90 days. Rye is used exclusively for bread. It is made in round cakes, about 1 foot in diameter, and from $\frac{1}{4}$ to $\frac{1}{2}$ inch thick. After baking, the cakes are thoroughly dried and become very hard, but are easily soaked for use. This bread is considered very healthy and nutritious. The cakes will keep any length of time. Culture. Rye bread.

The average yield of wheat per acre is about 22.70 bushels; rye, 23½ bushels; barley, 29½ bushels; oats, 37½ bushels; and millet, 36½ bushels. The amount of the crop of 1875 was: Yield of cereals per acre.

	Bushels.	
Wheat	283,000	Crop of 1875.
Rye	971,000	
Barley	4,500,000	
Mixed grain	1,800,000	
Oats	9,200,000	
Pease	240,000	
Potatoes	22,000,000	

The following are the average annual importations of animal products from 1871 to 1877: Importation of animal products.

	Pounds.
Butter	6,581,250
Cheese	630,000
Meat and lard	9,130,000
Suet	272,250
Hides	4,185,000
Wool	327,000

NORW.

The agricultural exhibits of Norway consisted principally of red winter and spring wheat, oats, barley, rye, pease, beans, seeds, grapes, etc., grain in the sheaf, and grasses, and a sample of pea-vine which measured 9 feet in length.

RUSSIA.

RUSSIA.

The Russian department was interesting to the practical agriculturist, representing, as it did, nearly all of the agri-

Exhibit of cereals,

cultural products of that vast country. Among the cereal exhibits were many samples of fair winter and spring wheat, also good samples of oats, rye, barley, millet, and buckwheat.

Among the miscellaneous products were fine specimens of

and other crops.

sorghum, flax, hemp, grapes, etc., indicating good cultivation and a productive soil.

The yield of the staple crops in 1870 was:

Yield of staples, 1870.

	Bushels per acre.	Entire crop.
		Bushels.
Wheat	17	221,360,342
Rye	17	616,938,768
Barley	26	124,051,128
Oats	32	589,774,616
Millet and other small grain		97,905,800
Potatoes		326,352,302

Number of domestic animals.

The domestic animals of the country in 1870 were as follows:

Horses	16,160,000
Cattle	22,770,000
Sheep	46,432,000
Swine	9,800,000
Goats	1,700,000

NETHERLANDS.

NETHERLANDS.

Exhibits of dairy products.

Among the agricultural products of Holland which were on exhibition cheese and other dairy products occupied the most prominent position, while there were beautiful sam-

Cereals, etc.

ples of white and red wheat, corn, and other cereals, including a collection of grain in the sheaf; also leguminous plants, tobacco, and flax.

The agricultural lands of Holland are divided as follows:

Division of the agricultural lands.

	Acres.
Maritime towns	169,600
Woods and plantations	562,500
Grazing and meadow lands	1,600,325
Proper agricultural lands	4,367,595
Uncultivated lands	1,561,650
Total	8,261,669

The cereal products in 1873 amounted to 33,587,000 bushels, of which wheat formed about 15½ per cent.; rye, 27½ per cent.; oats, 33⅓ per cent.; barley, 14 per cent.; and buckwheat, 9½ per cent. The average annual yield per acre in bushels is 24 of wheat, 18⅓ of rye, 42 of barley, 43 of oats, and 15⅕ of buckwheat.

Production of cereals.

In some of the provinces most of the land is cultivated in rye, and for "five centuries buckwheat has replaced the dead fallow."

The following table shows in bushels the production, importation, exportation, and consumption of products for the year 1872:

Production, importation, exportation, and consumption of agricultural products.

	Production.	Importation.	Exportation.	Consumption.
Wheat	5,528,000	3,516,000	374,000	8,670,000
Rye	11,246,000	6,363,666	161,500	17,447,660
Barley	3,661,666	2,669,000	700,830	5,700,833
Oats	10,834,660	158,666	1,113,500	9,879,833
Buckwheat	2,887,166	589,333	14,166	3,462,333
Beans	3,402,833	161,500	260,666	3,303,666
Potatoes	52,093,000	549,666	2,102,333	51,541,166

Oat-meal is extensively used as an article of food, and the annual importations exceed the exportations.

On nearly every farm a portion of the land is manured with great care, on which potatoes, oats, barley, rye, colza, flax, and clover are raised for home consumption. Fall turnips are sown after the grain crops, and are used for feeding cattle in winter.

The following is the rotation of crops most commonly practiced:

Rotation of crops.

1st year.—Rye.
2d year.—Beans.
3d year.—Wheat.
4th year.—Oats.
5th year.—Clover.
6th year.—Wheat.

More attention is paid to the raising of fine stock and to the dairy than to the raising of crops from the soil. Immense quantities of butter and cheese are made and exported.

Dairy products of superior importance.

GREECE.

Greece exhibited good samples of nearly all the cereal products raised in Europe, of pease, coffee-beans, olives, dried small fruits, raisins, and honey; also of vermicelli and macaroni made from a mixture of corn-meal and flour.

Area of cultivated land.

The whole amount of land under cultivation is estimated at 1,025,417 acres.

GREECE.

The production for the year 1875 was:

Production of cereals, etc.

	Bushels per acre.	Entire crop.
		Bushels.
Wheat	12¾	4,364,231
Wheat and rye, mixed		1,422,364
Rye	11½	16,045
Barley	18½	1,670,672
Corn	17	2,783,169
Oats	19⅛	122,652
Vegetables		168,710
Potatoes		102,578
Millet	11½	64,150
Rice		1,567

Wheat.

The production of wheat is not sufficient for home consumption, and the annual importations average nearly 4,000,000 of bushels.

Olives.

The olive is largely cultivated, and olive-oil is the principal article of export.

Honey and wax.

Honey and wax are produced in large quantities.

Wool.

Wool is a staple product. In 1875 there were in the country 2,291,917 sheep, under the special charge of 44,532 shepherds.

Small farms. Mode of working.

The farms are generally small, and oxen are mostly used for farm-work, although of late horses and mules are being introduced. In some of the districts the land is divided into very small parcels, varying from ¼ to 2½ acres. Some farmers own from 10 to 25 acres, and a small number from 100 to 200 acres. The greater portion of the laborers are also proprietors of a small portion of the land they cultivate.

Exportation and importation of farm products.

The annual exportations of farm products amount to nearly $10,000,000; the importations to about $7,000,000.

But little enterprise.

Agriculture in Greece has remained nearly stationary for a long number of years, the farmers showing but little enterprise, and consequently making but little progress. Of late, however, the government has evinced some disposition to encourage and aid agriculture by the diffusion of instruction and technical knowledge relating to the science of agriculture, and it is said that the situation is beginning to improve.

Possible improvement.

SWITZERLAND.

SWITZERLAND.

Products.

The agricultural exhibits of Switzerland consisted principally of cereals, lentils, root products, including arrow-root, cassava, vermicelli, tapioca, macaroni, and other manufactured farinaceous products.

Population and territory.

In 1868 Switzerland had a total population of 2,669,147 inhabitants and a total territory of 10,354,500 acres.

SWITZERLAND.

The cereal products of that year amounted to 17,544,000 bushels, of which there were of—

Cereal products.

	Bushels.
Wheat	2,142,000
Rye	8,670,000
Barley	1,428,000
Oats	5,304,000

The same year there were in the country the following number of domestic animals:

Domestic animals.

Horses	105,792
Cattle	992,895
Sheep	445,400
Swine	304,191
Goats	374,481

The whole country produces only about one-third of the amount of cereals required for home consumption.

PORTUGAL.

PORTUGAL.

Population.

Territory.

In 1875 the population of Portugal was 4,012,000, and the total territory 22,771,750 acres.

The food products for that year were as follows:

Cereal products.

	Acres.	Entire crop.	Bushels per acre.
		Bushels.	
Wheat	625,957	5,675,348	12½
Rye	999,537	6,229,188	8
Barley	174,877	1,981,398	15¾
Oats	29,985	567,513	18⅞
Corn	778,290	15,790,937	15
Potatoes	33,342	3,777,816	.....

The number of domestic animals in 1870 was:

Domestic animals.

Horses	79,605
Asses	137,950
Mules	50,690
Cattle	520,474
Sheep	2,706,777
Swine	776,868
Goats	936,869

Exhibits.

Portugal exhibited cereals, lentils, roots, and farinaceous products.

The cereal products of the country are less than one-half of the amount required for home consumption.

ITALY.

ITALY.

Population and territory.

In 1873 Italy had a population of 26,801,154 inhabitants, and a total territory of 64,830,000 acres.

ITALY.

The food products of 1868 were:

Production of cereals and vegetables.

	Bushels.
Wheat	107,204,507
Rye	8,726,513
Barley	23,272,886
Corn	50,964,166
Millet and other small grain	19,995,172
Dry vegetables	12,329,206
Potatoes	29,648,986

The domestic animals for the same year were:

Domestic animals.

Horses	477,906
Asses	498,766
Mules	219,456
Cattle	3,473,934
Sheep	6,984,049
Swine	1,553,582
Goats	1,690,478

Percentage of the various cereals to gross product.

The average annual production of cereals amounted to 210,562,000 bushels, of which wheat amounts to 51 per cent.; rye, 4 per cent.; barley, 11 per cent.; corn, 24 per cent.; and millet, 10 per cent.

The country produces only about one-half of the amount of cereals required for home consumption.

SWEDEN.

SWEDEN.

Exhibits.

The agricultural exhibits of Sweden consisted principally of cereal products, tuberous and leguminous plants, all good samples, indicating good husbandry.

Products.

Agricultural products.

Cereals.

The cereal products of the country are principally wheat, rye, oats, barley, and buckwheat.

Roots.

The root plants are potatoes, radishes, turnips, carrots, and beets. Among the leguminous plants, pease and horse-beans are most extensively cultivated. Lentils are also cultivated for fodder and for the seeds.

Yield.

The average yield of fall grain is seven, eight, or nine times the amount of seed sown; of spring grain, five, six, or seven times the amount of seed; and of potatoes, from seven to eight fold.

The following were the amounts of the principal crops produced in 1877:

Cereal products, 1877.

	Bushels.
Wheat	2,992,016
Rye	16,378,366
Barley	13,160,516
Oats	47,642,216
Pease	5,280,483

	Bushels.
Rape-seed	2,559,066
Buckwheat	73,383
Potatoes	43,984,387

Products in 1877.

The whole amount of root crops for that year was estimated at 5,666,666 bushels.

Beets.

Beets are quite extensively raised for the manufacture of sugar in some of the provinces. From 10 to 15 tons to the acre is considered a good crop, and is about the average with good cultivation.

More cereals are produced than are required for home consumption, notwithstanding that a considerable quantity is manufactured into Swedish whisky. Potatoes and other tubers are also used for that purpose.

Exports and imports.

Exports and imports.

The surplus of cereal products are exported principally to England, France, Belgium, and Norway.

The following were the values of exports for 1876, consisting mainly of oats and a small quantity of rye:

To England	$8,205,000
To France	1,800,000
To Belgium	1,000,000
Total	11,005,000

At the same time rye and flour were imported in considerable quantities from Russia and Denmark. The amount of these importations in 1876 was nearly $4,000,000.

Governmental encouragement of agriculture, schools, and societies.

Agricultural schools and societies.

Agriculture is largely encouraged by the government. The Agricultural Department is indirectly under the control of the Secretary of the Interior, but its chief management devolves upon the Royal Agricultural Academy, founded in 1811, which is not only a scientific institution, but the central establishment for the encouragement and development of agriculture. There are in connection with it a model farm for experimental purposes and a school of physiology and agricultural chemistry. Four other chemical schools have been established since 1876, supported partly by the government and partly by agricultural societies. These societies, to the number of 20, have been organized in the different provinces for the promotion of agriculture, and make annual reports to the Agricultural Academy and to the Central Office of Statistics. The gov-

Governmental encouragement.

Royal Agricultural Academy.

Model farm.

Chemical schools.

Reports.

SWEDEN.

ernment appoints and pays 14 agricultural engineers, whose duty is to furnish farmers generally with information on all matters connected with farming and the interests of agriculture. Theoretical and practical instructions are also given by 2 agricultural colleges and 27 farm schools. Through the influence of these institutions agriculture, especially in the direction of stock raising, has been greatly improved. Dairy schools also have been established in the different provinces, where practical and scientific instruction is given by professors appointed by the Agricultural Academy and paid by the government, on all subjects relating to the production of milk, the manufacture of butter and cheese, and the manipulation and disposition of farm products.

Agricultural engineers.

Colleges and schools.

Dairy schools.

Dairy societies. Dairy societies have recently been organized, which, in co-operation with the schools and efforts of the government, are revolutionizing the dairy business of the country. The new method of cooling the milk with ice-water is universally recommended and generally practiced.

Live stock.

Live stock.

To encourage the raising of cattle, and for the improvement of the breeds, the government has from time to time imported animals of foreign breeds, principally the shorthorns, Ayrshires, and Holland race (Holstein). The latter are highly prized for dairy purposes.

Imported cattle.

Traveling instructors. Two traveling instructors visit different parts of the country, deliver lectures, and give instructions on stock breeding and the care of cattle.

Model sheep farms. There are also a number of model government sheep farms, and the government provides a traveling inspector to visit annually the sheep farms of the country and give instructions on breeding, management, and the production of wool.

Government studs. The government owns 1 stud and 2 depots of stallions. These three establishments had in 1875 323 horses.

Cavalry regiments have stallions exclusively for breeding purposes. To still further the improvement of horses the government gives liberal prizes to breeders.

The animals generally employed on the farms are horses and oxen.

Labor.

Agricultural labor.

The farm laborers of Sweden generally work either for a certain salary by the year or give a certain number of days' work in lieu of rent for the land they occupy and cultivate.

SWEDEN.

Men who labor upon the farms in summer are paid from $25 to $50 a year, with board, and women from $12.50 to $16. Women as a rule work in the fields. A man with a family who engages to labor upon a farm generally receives about $100 a year, from $25 to $30 in cash and from $70 to $75 "in kind," without board, but with rent, wood, etc., furnished.

Agricultural labor.

Wages.

In Sweden as well as in Norway rye cakes are used by all classes as a common article of food.

DENMARK.

DENMARK.

Exhibit.

The exhibits consisted of winter wheat, rye, oats, barley, pease, seeds, etc. Several samples of red winter wheat of superior quality were in the collection.

Agriculture is the chief occupation of the people and the principal source of wealth. Considerable improvement has been made in Danish agriculture in the last thirty years; nevertheless, there are still large tracts of uncultivated land. Of the cultivated land 37 per cent. is made to produce cereals annually, and 38 per cent. is in meadows, pastures, and fallow.

Rotation of crops.

Rotation of crops.

The following is the common system of rotation of crops:

1st year.—Roots.
2d year.—Wheat.
3d year.—Barley.
4th year.—One-half oats, the other half in leguminous plants or roots.
5th year.—Clover follows the oats, and oats follow the leguminous plants and roots.

Sometimes a mixture of oats and pease follow roots and leguminous plants for a green crop.

Live stock.

Live stock.

Dairy husbandry.

Formerly sheep husbandry occupied a prominent place in the agriculture of the country, but of late the dairy business has taken its place. Butter and cheese are the staple products. A large amount of butter is exported to England and South America.

Exports.

Exports.

Barley is exported to England for the brewers. But little spring wheat is grown.

Protection of the quality of seed.

Protection of the quality of seed.

A system has been inaugurated by a firm in Copenhagen by which farmers are protected from imposition by seedsmen. The grain and seeds are analyzed and a statement of

DENMARK.

Protection of the quality of seed.

the analysis furnished with the seed sold. The analysis states the number of grains or seeds in a bushel, the amount of foreign substance, the percentage of seeds or grains that will germinate, and their relative value. For all grain or seeds sold that do not come up to the standard the money is refunded and all damages paid. They guarantee (1st) genuineness, (2d) purity, and (3d) germinative powers.

Products.

Products.

Of the cereal products wheat forms about 4½ per cent.; rye, 15 per cent.; barley, 29 per cent.; oats, 46 per cent.; millet, 4½ per cent.; and buckwheat, 1 per cent.

The cereal products of the country in 1873 were:

Cereals.

	Entire crop.	Bushels per acre.
	Bushels.	
Wheat	2,743,532	19⅛
Rye	9,125,226	14⅜
Barley	17,232,538	22¼
Oats	27,316,036	29⅛
Millet	2,624,248	31½
Buckwheat	596,420	12½
Total	59,642,000	

This provides about 32 bushels per each inhabitant.

SPAIN.

SPAIN.

Exhibit.

The Spanish Agricultural Building was well filled and artistically arranged. There was a very large collection of cereal products, including a large variety of yellow, white, and red ears of corn, also olive-oil, canned fruit, etc.

Wine.

One sample of spring wheat was very remarkable for its whiteness and plumpness. The horse-bean is extensively grown for horses, and grapes for wine; 50,000 bottles of wine were on exhibition.

Yield of cereals per acre.

The average yield of wheat per acre is about 15½ bushels; rye, 8 bushels; and barley, 18 bushels. Of the cereal products, wheat amounts to 52 per cent.; barley, 26 per cent.; rye, 11 per cent.; and Indian corn, about 11 per cent.

The following is the amount of cereal products for 1873:

Cereals product.

	Bushels.
Wheat	117,417,040
Rye	25,289,824
Corn	24,612,418
Barley	58,482,718
Total	225,802,000

This is about 13⅞ bushels for each inhabitant.

BELGIUM.

BELGIUM.

The agriculture of Belgium was well represented in the Exposition. The samples of wheat, rye, oats, barley, millet, buckwheat, corn, rice, flour, and meal, both pure and mixed, also of bread, pastry, vermicelli, macaroni, and other food preparations from cereals were creditable not only to the agriculture of the country but to its household economy. There was also a large and fine collection of vegetable products, including tapioca, arrowroot, etc.; also of salt and preserved meats of the choicest selections, well prepared and preserved.

Exhibit.

The average annual production is as follows:

Yearly farm crop product.

	Bushels.
Cereals, about	72,000,000
Leguminous plants	2,100,000
Root crops	106,000,000

Of the cereal products, wheat yields about 33 per cent.; oats, 33 per cent.; rye, 24 per cent.; barley, 5 per cent.; mixed grain, 3 per cent.; and buckwheat, 2 per cent.

Relative percentage of the cereal products.

The average yield per acre in bushels is wheat, 27⅓; rye, 25; oats, 42; barley, 34; and buckwheat, 24.

Yield.

In 1866 there were in Belgium—

Cattle	1,242,445
Horses	283,166
Sheep	583,485
Swine	632,301

Domestic animals.

The government has established 1 veterinary college, 1 agricultural institute, and 2 schools of practical horticulture. There are also "agricultural conferences" held in different parts of the country under the auspices of the government. The agricultural societies have a total membership of over 17,000. Notwithstanding all this, much of the field labor is performed by women, and many of the plows and implements used on the farms are of the rudest make and remind one of past ages.

Colleges, institutes, and schools.

Conferences.

The average value of farming land is about $300 an acre.

Value of land.

THE GERMAN EMPIRE,

GERMANY.

INCLUDING PRUSSIA, BAVARIA, SAXONY, WÜRTEMBERG, BADEN, HESSE-DARMSTADT, SAXE-WEIMAR, AND SAXE-ALTENBURG.

It is to be regretted that the relations between the Republic of France and the German Empire were such as to preclude that great and rich agricultural country from being represented in the Exposition.

GERMANY.

The following items are compiled from the German statistics for 1873.

Population.

Territory.

The number of inhabitants at that time was 36,624,648, and there were under cultivation 121,872,592 acres of land.

Food products in 1873.

Food products, 1873.

	Acres.	Bushels.
Wheat and spelt (German wheat)	5,332,383	110,497,251
Mixed grain (Meslin)	109,640	1,559,033
Rye	12,617,295	205,788,955
Barley	5,047,235	118,816,459
Oats	8,658,647	271,744,107
Corn	14,332	300,625
Buckwheat	25,027	102,073
Millet	34,085	737,746
Dry vegetables	218,252	20,042,070
Potatoes	1,440,320	682,505,128

Domestic animals in 1873.

Domestic animals.

Horses	2,976,277
Asses	9,828
Mules	1,093
Cattle	14,386,791
Sheep	22,295,682
Swine	6,360,415
Goats	2,027,756

Varying productiveness of different regions.

The soil and climate of a large portion of Germany are favorable for agricultural operations. The country called the Black Forest is poor, and a large portion is barren and uncultivated. The valley of the Rhine, so celebrated for its vineyards, produces also excellent crops of cereals, vegetables, tobacco, hops, flax, chicory, and sugar-beets. The borders of Lake Constance and the valley of the Tauber produce vines in great perfection.

Triennial system of rotation of crops.

The triennial system of rotation of crops is generally practiced in the cereal-producing sections of the country:

1st year.—Winter wheat.
2d year.—Spring wheat.
3d year.—Clover or vegetables.

A certain rotation obligatory in places.

The rotation for some localities is fixed by the administration. The cultivated lands of a commune are divided into three parts, and a certain rotation made obligatory. This system is denounced by many of the best farmers as "irrational and detrimental to the best interests of agriculture on account of the extreme division of agricultural lands and the insufficiency of roads and drive-ways communicating between different pieces of land belonging to the same proprietor."

The agriculture of Baden, Hesse-Darmstadt, and some other provinces is very similar, and the rotations are accompanied by a triennial manuring.

GERMANY.

In the Grand Duchy of Saxe-Weimar for 25 years the administration has appointed an agricultural committee, one member of which visits the country periodically, for the purpose of introducing new systems and reforming old ones, also to disseminate general information relating to farming. The practical results of this system do not seem to be satisfactory if we may judge from the following conclusions embodied in the last agricultural reports:

Saxe-Weimar.

Agricultural committee.

"The peasants, either through indolence or ignorance, do not generally cultivate the soil more than three or four inches deep."

Unsatisfactory report on condition of agriculture.

"Manure, domestic animals, agricultural implements, even forage and straw, seem to be as a general thing wanting."

"The cattle pass most of the summer and fall in poor pastures, and the bulls are badly fed and put in service when too young, producing inferior offspring, so that the race is degenerating instead of improving."

"The triennial rotation is most in use, but there is a large amount of poor and unproductive land, and the cultivation of the soil is fettered by the extreme parceling of the farms and the insufficient means of communication between different parcels."

TURKEY IN EUROPE.

TURKEY IN EUROPE.

In 1868 the population of Turkey in Europe amounted to 8,700,000 inhabitants, and the territory under cultivation was 91,009,250 acres.

Population.

Land in cultivation.

The cereal products for that year were as follows:

Cereal products.

	Bushels.
Wheat	40,800,000
Rye	10,200,000
Barley	25,500,000
Oats	3,060,000
Corn	30,600,000
Rice	2,040,000
Total	112,200,000

This gives about 13 bushels for each inhabitant, or 30,450,000 bushels less than was required for home consumption.

ROUMANIA.

ROUMANIA.

The population of Roumania in 1873 was 4,500,000 inhabitants, and the total territory 30,243,250 acres.

Population.

Territory.

Area and amount of cereal products in 1873.

Cereal products.

	Acres.	Bushels.
Wheat and spelt (German wheat)	2,480,265	33,741,604
Rye	259,302	5,877,520
Barley	885,057	20,061,300
Oats	248,105	8,435,570
Corn	3,195,230	108,637,820
Buckwheat	11,485	226,946
Millet and other small grain	226,575	7,389,980

ROUMANIA.

It will be seen from this that Roumania excels all other countries in Europe in the production of Indian corn. The Maize. average yield is 34 bushels per acre, and the amount produced constitutes 59 per cent. of all the cereal products. The yield per acre of corn and its percentage of the cereal products will compare favorably with the corn crop of the United States.

FINLAND.

FINLAND.

Population. In 1870 Finland had a population of 1,832,000 and a territory Territory of 94,463,250 acres of land.

Area and amount of cereal products in 1870.

Cereal products.

	Acres.	Bushels.
Wheat	5,000	53,833
Rye	662,500	9,010,000
Barley	275,000	4,986,000
Oats	225,000	4,845,000
Buckwheat	1,000	17,000
Millet and other small grain	12,500	141,666

Potato crop. The potato crop for that year amounted to 50,000 bushels.

Domestic animals in 1870.

Domestic animals.

Horses	254,820
Cattle	997,960
Sheep	921,745
Swine	190,326
Goats	30,639

The production of cereals is 5,500,000 bushels less than is required for home consumption.

SERVIA.

SERVIA.

Population. The population of Servia in 1868 was 1,338,505 and the Land in cultivation. territory under cultivation 10,888,750 acres.

Cereal products in 1868.

Cereal products.

	Bushels.
Wheat	4,080,000
Rye	510,000
Barley	3,060,000
Oats	510,000
Corn	5,100,000
Buckwheat	1,220,000

Maize. The corn crop of Servia constitutes 35½ per cent. of the cereal products. The annual importations of cereals amount to 6½ millions of bushels.

AUSTRALIA.

AUSTRALIA.

The Australian colonies had taken advantage of the Centennial Exhibition to exhibit their products and win

honors that brought them into general notice throughout the world. Encouraged by their achievements at Philadelphia, they again entered the field with other nations, and placed on exhibition at Paris well selected and prepared samples of nearly all their staple products—wheat, corn, oats, barley, rye, millet, root products, tobacco, fibrous plants, dyeing materials, sugar, tea, coffee, etc.; also farinaceous products, bread and pastry, fatty substances used as food, preserved meats and fish, and dried and preserved vegetables and fruits.

Exhibit in Philadelphia, 1876.

Character and importance of exhibit in Paris.

The progress and development of the resources of these colonies have been wonderful. In thirty years the population has increased from 214,000 to nearly 2,000,000 souls. In the same time the commerce of the colonies has increased 950 per cent.; and 5,600,000 tons of shipping entered and cleared the ports in 1874. In 1878 there were nearly 5,000,000 acres of land under cultivation and 70,000,000 head of live stock in the pastures. The farms are well supplied with improved implements and machinery, some portion of which is imported from the United States.

Wonderful progress and development.

Population.

Commerce.

Land in cultivation.

Live stock.

New South Wales, "the mother colony," has a superficial area of 323,437 square miles and a population, according to the census of 1875, of 606,632.

New South Wales.

Area and population.

Staple crops in 1876.

Product of staple crops in 1876.

	Production.	Acres.
Wheat ..... bushels..	1, 958, 640	133, 609
Corn ..... do...	3, 410, 517	117, 582
Barley ..... do...	98, 576	4, 817
Oats ..... do...	332, 966	18, 855
Rye ..... do ..	11, 756	918
Potatoes ..... tons..	41, 203	13, 805
Sown grasses ....do...	17, 708	10, 241
Orchards, gardens, and pastures	.....	20, 600

Wheat and corn are the principal cereals. The average yield of wheat for the last decade has been 12½ bushels per acre; that of corn 31 bushels. Corn is mainly cultivated on the rich bottom lands of the coast rivers.

Yield of cereals per acre.

Much attention is paid to stock raising and the production of wool. In 1875 there were in the colony 22,872,882 sheep, 2,856,699 cattle, and 346,691 horses. Wool is the principal article of export. In 1875 the exportation of wool amounted to 87,500,000 lbs.

Stock raising.

Export of wool.

South Australia is termed the "granary of Australia," its soil and climate being favorable for the growth of wheat. It has a total area of 903,690 square miles, or 278,336,000 acres. About two-thirds of the cultivated land is cropped in wheat. The area in wheat in 1877 was 1,083,732 acres.

South Australia.

Area.

Area in wheat.

AUSTRALIA.

The export of wheat and flour amounts to about 200,000 tons annually. The quality of the wheat is superior; one sample on exhibition weighed 68 lbs. per imperial bushel. The population of the colony in 1877 was estimated at 237,000, of which 75 per cent. are engaged in agricultural pursuits and mining.

South Australia.

Superior wheat.

Victoria.

Victoria has a territory of 56,446,720 acres of land, of which about 20,000,000 acres are in mountain ranges and swamps, and consequently of but little agricultural value. In 1877 the population was estimated at 850,000.

Area and population.

Wheat, oats, barley, potatoes, and hay are the standard crops. Corn is largely used for feeding horses, but is principally imported from New South Wales.

Acreage and yield of staple crops.

Acreage and yield of staple crops in 1876.

	Production.	Acres.
Wheat.....bushels..	5,279,730	401,417
Oats.....do....	2,294,222	115,206
Barley.....do .	530,323	25,034
Potatoes.....tons..	134,082	40,450
Hay .....do....	180,560	147,408
Green forage..... ...	....	362,554

In addition to the above, Victoria produces almost every variety of vegetables, including tobacco, flax, sugar-cane, etc. In 1875 the colony exported 85,064,952 lbs. of wool and imported a large amount of corn and breadstuffs.

Exports of wool.

Queensland.

Queensland is, excepting Western Australia, the most recently established of the Australian colonies. It has an area of 420,492,800 acres and a population of about 188,000 persons. The people are largely engaged in stock raising. In 1876 there were in the colony 130,289 horses, 1,985,807 cattle, and 7,241,810 sheep. Wool and animal products constitute the principal agricultural exports.

Area and population.

Stock-raising.

Darling Downs.

The principal wheat-growing districts are on the Darling Downs, situated on an elevation of 2,000 ft. above the level of the sea. Corn is raised on the alluvial lands on the tidal rivers. The statistics for 1876 give the "area of wheat under cultivation at 5,967 acres, of which 1,163 acres were affected with rust and 347 acres entirely destroyed"; yet the yield was 91,170 bushels, or nearly 20½ bushels per acre. Beautiful samples of white wheat were exhibited, weighing, respectively, 68 lbs. 5½ oz., 68 lbs. 8 oz., and 68 lbs. 10 oz. per bushel. The choicest varieties of wheat produced in the colonies are the White Tuscan, White Lammas, Talavera, and Dalton. Sugar is a leading agricultural product in Queensland, the amount produced in 1877 exceeding 14,000 tons.

Maize.

Wheat.

Sugar.

AUSTRALIA.

The different grades of Australian wool were well represented, and occupied a prominent position among the agricultural exhibits of all the colonies. The quality and condition of these wools elicited universal admiration, and cannot fail to add to the reputation of and consequently increase the demand for Australian wools among the wool-importing nations of the world.

Admirable quality of wool.

Population and estimated annual cereal product of the Australian colonies.

Population and cereal product of Australian colonies.

	Population.	Bushels of cereals.	Bushels per inhabitant.
New South Wales	606,632	5,812,455	9½
South Australia	237,000	10,273,500	42
Victoria	850,000	7,598,986	9
Queensland	188,000	1,879 000	10
Total	1,881,632	25,563,941	13 6/10

From the above it will be seen that South Australia is the only colony that produces a surplus of cereals, and that surplus is not sufficient to supply the deficiencies in the other colonies by nearly 4,000,000 bushels.

ARGENTINE REPUBLIC.

THE ARGENTINE REPUBLIC.

Admirable exhibit.

This young and enterprising republic made an exhibit of her agricultural products which for variety, quality, value, and points of interest were unsurpassed by some of the older countries. Among this collection were samples of wheat, rye, oats, barley, corn, clover and grass seeds, potatoes, roots, sugar, coffee, gums, etc.; also grasses and plants used for forage and pasture. There was also a large and well-selected assortment of the different grades of wool produced in the country, showing quality, condition, and purposes for which the various staples were specially adapted.

Low standard of agriculture.

The quality of the wheat is inferior to that of Australia or the United States, and perhaps of some cereal-producing countries of Europe. This is attributed to the low standard of agriculture which almost universally prevails. Wooden plows are yet used in many places, and the soil is superficially and imperfectly cultivated.

Stock-raising.

Stock-raising receives the most attention, and at present is the most remunerative, although the soil and climate seem to be well adapted to a mixed husbandry.

ARGENTINE REPUBLIC.

Domestic animals in 1875.

		Number.	Value.
Domestic animals.	Horses	3,960,331	$17,602,170
	Cattle	13,493,090	84,433,358
	Sheep	57,546,448	84,234,369
	Swine	257,368	617,868
	Goats	2,863,227	2,710,756

Product of wool. The annual production of wool is estimated at nearly 200,000,000 lbs. in its unwashed state, and constitutes the principal article of export. It is classified in the produce depots, called *barracas*, then baled for shipment. Sheepskins are exported in large quantities to France.

Sheepskins.

Product of slaughtered animals. Fat animals are slaughtered at the salting establishments, called *saladeros*. The meat is cut into thin slabs and piled up in large stacks with salt, and afterwards dried upon scaffolds. It is then known in commerce under the name of *carne tasajo*. This defective preparation of meat does not render it palatable to the European epicure, and therefore it fails to find a ready market on the Continent. Its principal market is in Brazil and Cuba, where it is used as food for the slaves. The tallow and grease are tried out in steam-boilers and run into casks. The hides are stretched on scaffolds and dried, then saturated with a poisonous solution to protect them from moths and worms, and baled for shipment.

Market for the meat product.

Tallow and hides.

Another method of preserving meat which has lately been introduced is to "cut the meat into strings and dry it in the sun without salt." This process makes it more nourishing and palatable than the former method. It is called in commerce *charque dulce*. But little, however, is exported.

Grease factories. "Grease factories" have also been established in different parts of the country, where the whole carcass of animals, after being stripped of the hide, is thrown into a large boiler and the grease tried out. The bones are then ground into flour for the English market, and the cooked flesh used for fuel. Horses unfit for service are disposed of in this way, and the grease is known in commerce as "animal-oil." The hides are salted and exported. The manufactured leather from horse-hides is extensively used for carriage trimmings.

Population. The republic has a population of about 2,400,000. The government has shown commendable zeal in exhibiting the agricultural products of the country at the great international exhibitions, and disseminating information upon the developed and undeveloped resources of the republic.

CANADA.

Exhibit.

Canada exhibited cereals, leguminous plants, and other farm products of good quality. Two samples of wheat were among the best on exhibition.

The following were the principal cereal products of 1871:

Cereal products.

	Bushels.
Spring wheat	10,959,000
Winter wheat	6,568,942
Oats	47,110,666
Barley	12,030,733
Rye	1,090,834
Buckwheat	3,321,399
Corn	3,850,766

The provinces of Ontario and Quebec raise five-sixths of the total cereal production.

Exports.

The principal product is oats, next wheat, and third barley.

In 1874 there were exported 6,800,000 bushels of wheat.

Dairy farming.

Dairy farming is extensively carried on, and a large amount of cheese is exported to England.

In 1871 there were in all the provinces—

Domestic animals.

Horses	862,072
Sheep	3,302,873
Cattle	2,687,274
Swine	1,281,563

A few other nationalities exhibited agricultural products, but difficulties attending the collection of accurate information relating to the agriculture of the countries is the reason why they are not noticed in this report.

The following summary will indicate very nearly the average amount of the cereal productions of Europe, and the countries of Europe which furnish a surplus for commerce; also those which are obliged to import breadstuffs for home consumption

Table of—

Counties.
Population.
Cereal products and percentage of various cereals relative to gross products.

Average cereal productions of Europe.

Countries.	Population.	Bushels.	Percentage of the different cereals.							
			Wheat.	Mixed grain.	Rye.	Barley.	Oats.	Corn.	Buck-wheat.	Millet and other grain.
Great Britain	26,785,000	320,840,000	32.8	.....	.6	28.7	37.9	.....	.....	.....
Ireland	5,327,000	69,380,000	5.6	.....	.2	12	82.2	.....	.....	.....
Denmark	1,785,000	59,642,000	4.6	.....	15.3	28.9	45.8	1	.....	4.4
Norway	1,763,000	15,289,000	1.8	.....	5.4	24.9	56.3	.....	.....	12.1
Sweden	4,298,000	66,643,000	3.7	.....	22.4	18.9	47.9	.....	.....	7.1
Russia	71,731,000	1,655,021,000	13.4	.....	37.3	7.5	35.6	.....	.....	6.2
Finland	1,832,000	22,862,000	.....	.....	49.9	27.1	21.9	.....	.....	.6
Austria	20,395,000	269,084,000	13.4	.....	27.6	17.2	33.9	.1	3.1	.6
Hungary	15,509,000	300,330,000	1.8	.....	5.1	24.3	56.4	.....	.....	12.1
Switzerland	2,669,000	17,554,000	12.2	.....	49.4	8.2	30.2	.....	.....	.....
Prussia	24,656,000	560,089,000	13.1	.....	30.9	15.5	40.5	.....	.....	.....
Bavaria	4,852,000	89,666,000	24.1	.....	27.3	19.5	28.8	.1	.1	.1
Saxony	2,556,000	27,645,000	19.3	.....	44.3	21	14.3	.....	1.1	.....
Würtemberg	1,818,000	24,862,000	29.8	2.9	6.8	22	38.2	.3	.....	.....
German duchies	2,742,000	39,859,000	26.2	2.7	19.1	25.4	24.8	.6	.1	1.1
Holland	3,716,400	33,587,000	15.6	.....	27.6	14.1	33.3	.....	9.4	.....
Belgium	5,254,000	72,261,000	32.7	2.8	24.7	5.2	32.8	.....	1.8	.....
France	36,103,000	710,130,000	41.6	3.1	10.5	8.1	28	3.8	4.6	.3
Portugal	4,012,000	31,813,000	25.6	.....	8.9	8.9	1.7	37.4	.....	.....
Spain	16,202,000	225,802,000	52	.....	11.2	25.9	.....	10.9	.....	.....
Italy	26,801,000	210,562,000	50.9	.....	4.2	11	.....	24.2	.....	9.7
Greece	1,458,000	12,676,000	40.3	.....	.9	17.9	1.6	25.5	2.1	11.7
Turkey in Europe	8,700,000	112,200,000	36.4	.....	.9	22.7	2.8	27.3	.....	1.8
Servia	1,338,000	14,280,000	28.6	.....	3.6	21.4	3.6	35.7	3.6	.....
Roumania	4,500,000	184,161,000	18.3	.....	3.2	10.9	4.6	59	.1	3.9
Total	296,874,000	5,147,396,000	23.5	.7	22.9	13	29.3	6.8	.9	2.9
United States	48,000,000	1,583,669,000	18.3	.....	.9	2.2	17.5	60.6	.5	.....

Yield per acre of cereals in Europe, in bushels.

Yield per acre of cereals of Europe.

Countries.	Wheat.	Rye.	Barley.	Oats.	Corn.	Buck-wheat.	Millet.
Great Britain	29.46	34.00	38.53	45.33	.....	.....	.....
Ireland	22.62	20.46	35.20	36.37	.....	.....	.....
Denmark	19.20	14.73	22.66	29.46	.....	12.40	31.33
Norway	22.70	23.50	29.52	37.50	.....	.....	36.47
Sweden	.....	.....	.....	.....	.....	.....	.....
Finland	17.20	17.08	21.90	21.78	.....	18.34	11.33
Austria	14.97	15.00	17.08	19.52	15.00	14.00	13.60
Hungary	12.40	19.16	13.85	13.32	16.23	10.20	16.11
Russia	17.10	17.00	25.66	32.92	.....	.....	.....
Bavaria	20.40	12.54	20.42	22.69	25.64	11.42	17.00
Saxony	26.28	25.70	31.81	45.36	.....	17.00	.....
Würtemberg	32.80	18.13	23.83	28.43	21.60	17.00	17.00
German duchies	22.66	19.32	25.43	29.46	31.77	15.63	15.62
Holland	24.05	18.38	41.92	43.09	.....	19.20	.....
Belgium	27.30	25.60	34.60	44.93	.....	23.89	.....
France	17.00	15.10	20.40	25.60	18.13	18.41	15.10
Spain	15.63	7.99	18.13	.....	.....	.....	.....
Portugal	12.68	7.96	15.69	18.13	14.95	.....	.....
Roumania	13.60	22.66	22.65	34.00	34.00	19.20	31.33
Greece	12.79	11.33	18.41	19.20	17.03	11.33	11.32

It will be seen by the foregoing tables that the average annual production of cereals in Europe amounts to 5,147,396,000 bushels, of which Russia produces 1,655,021,000 bushels, or nearly one-third, the whole of Germany 765,000,000 bushels, France 710,130,000 bushels, and Hungary 300,330,000 bushels.

Average annual production of cereals in Europe.

But to arrive at the real importance of these productions the population of the different countries must be taken into consideration.

Average annual production of cereals per inhabitant in the different countries of Europe.

Production of cereals per inhabitant in European countries.

Countries.	Bushels.	Countries.	Bushels.
Roumania	40.8	Ireland	13.03
Denmark	32.42	Turkey	13.03
Russia	22.98	Finland	12.46
Prussia	22.66	Great Britain	11.90
France	19.55	Saxony	10.96
Hungary	19.36	Servia	10.96
Bavaria	18.42	Holland	9.06
Sweden	15.58	Norway	8.78
German duchies	14.45	Greece	8.78
Belgium	13.88	Italy	7.93
Spain	13.88	Portugal	7.93
Austria	13.32	Switzerland	5.95
Würtemberg	13.02		

According to the most moderate estimate, 15.58 bushels of cereals are required for home consumption. Hence it will be seen by the foregoing table that all of the countries after Sweden are constantly compelled to import foreign cereals.

The whole of Europe, with a population of 297,000,000 inhabitants, produces 5,147,396,000 bushels, or only about 17 bushels for every inhabitant; while the United States, with 40,000,000 inhabitants, produces 1,629,027,000 bushels, or 40 bushels for each inhabitant.

Relative production of cereals per inhabitant in Europe and in the United States.

Countries of Europe producing the most of specific cereals.

The countries of Europe which produce relatively the most wheat are Spain, Italy, and France; those which produce the most rye are Finland, Switzerland, and Germany; those having most barley are Sweden, Norway, Denmark, and Germany; those having most oats are Ireland, Sweden, Norway, Denmark, Hungary, and North Germany; those producing most corn are Roumania, Servia, and Portugal. But little buckwheat is raised except in Holland and France.

Deficiency of some countries in meat products.

It will also be seen that many of the European countries, more especially Great Britain and France, are largely deficient in meat products. They are now turning their attention to the United States for supplies; and the English and Irish stock raisers and feeders are greatly alarmed at the

Importation into Great Britain of American meats.

success which has attended the importation of fat cattle and dressed meat from this country. In it they see the same ruin to stock and meat raising in their countries as they experienced, from the importation of our cereals, to their wheat raising. It appears, however, that a new idea has just entered the English mind, and the importation of American cattle is to be made quite as beneficial and remunerative to the English feeders as it is to the American farmers. The

British feeding of American cattle.

"Edinburgh Scotchman" has counted the costs, and attempts to show that American cattle can be imported, and fed on English soil as the English feeders know how to do it, at a profit, even if the grain fed them is of foreign production.

All of this would be satisfactory to the American farmers who are seeking a market for their coarse grain and cattle, provided this system would be as remunerative to them;

Not flattering to our skill in feeding.

but certainly the idea is not flattering to our skill in feeding, and calls for more science, skill, and economy in this branch of American agriculture.

JOHN J. WOODMAN,
Additional Commissioner.

[NOTE.—The following figures, supplied by the Department of Agriculture, afford the latest accessible crop statistics for a portion of the countries referred to in the foregoing report.]

ABSTRACT OF THE PRINCIPAL CROPS OF EUROPEAN COUNTRIES.

Countries.	Date of statistics.	Maize.		Wheat.	
		Acres.	Product.	Acres.	Product.
			Bushels.		*Bushels.*
Great Britain	1879	.....	.....	2,890,244	.....
France	1878	1,519,230	29,823,389	16,902,419	269,616,081
Austria (excludiug Hungary)	1876	771,826	16,275,377	2,420,422	33,965,970
Russia	1872	.....	.....	28,743,390	157,938,000
Italy	1874	4,190,387	85,520,410	11,550,918	142,422,513
Holland	1874	.....	.....	235,611	6,189,546
Denmark	1876	.....	.....	140,350	3,893,738

Countries.	Date of statistics.	Rye.		Oats.	
		Acres.	Product.	Acres.	Product.
			Bushels.		*Bushels.*
Great Britain	1879	.....	.....	2,656,628	.....
France	1878	4,457,833	68,453,455	8,215,227	218,730,105
Austria (excluding Hungary)	1876	4,816,982	58,884,306	4,412,660	90,974,373
Russia	1872	66,398,540	546,832,000	32,818,890	543,622,750
Italy	1874	.....	.....	984,619	19,369,809
Holland	1874	498,994	9,810,108	277,569	12,647,712
Denmark	1876	574,841	13,791,089	864,254	24,266,743

Countries.	Date of statistics.	Barley.		Buckwheat.		Potatoes.	
		Acres.	Product.	Acres.	Product.	Acres.	Product.
			Bushels.		*Bushels.*		*Bushels.*
Great Britain	1879	2,667,176	.....	.....	.....	541,344	.....
France	1878	2,495,991	46,474,197	1,637,970	32,561,224	3,124,396	317,233,944
Austria (excluding Hungary)	1876	2,753,376	49,868,929	346,798	7,547,152	2,410,426	251,029,441
Russia	1872	15,511,600	124,753,750	11,307,660	86,256,500	3,169,010	370,876,000
Italy	1874	1,148,006	18,417,542	.....	.....	169,254	19,387,167
Holland	1874	122,216	5,415,338	162,272	3,398,469	326,986	54,481,014
Denmark	1876	698,946	17,997,560	49,625	467,879	95,772	10,356,998

LIVE STOCK.

SAMUEL DYSART.

REPORT ON LIVE STOCK.

The ground occupied by the stock exhibition was the *Esplanade des Invalides*, an open space and park lying between the *Hôtel des Invalides* and the river Seine. It is extensive, and has many beautiful shade trees planted in rows. Between the trees long sheds and pens of graceful proportions were erected, in the most complete order of arrangement, and the animals were well cared for.

Exhibition on the Esplanade des Invalides.

As might be expected at such an exhibition, the variety of breeds and the different family types of each species of stock were very great, ranging, to some extent, according to the character and soil of the country where grown and the manner of keeping. Much of the history of the country, the condition and intelligence of the people, may be read in the quality of their domestic animals. Where enterprise and intelligence go hand in hand, there we find improved breeds, and humane treatment of the same, while under other circumstances the condition of the stock is much inferior.

Great variety.

Quality and condition of cattle indicative of the character of the owners.

In order to convey to our people an idea of how few domestic animals we have in the United States for our territorial area, when compared with Europe, I have compiled the following table of statistics, gathered by the French Agricultural Bureau from the last census of each country:

Domestic animals to area in the United States and the different countries of Europe.

INTERNATIONAL COMPARISONS.

Area and number of domestic animals in the United States and in Europe.

Territorial area in acres.	Countries.	Horses.	Asses and mules.	Cattle.	Sheep.	Swine.	Goats.
Acres.							
1,921,492,480	United States	9,333,800	1,339,350	16,218,100	33,938,200	30,860,900	.....
79,352,000	Great Britain and Ireland	2,633,200	.....	10,144,500	33,977,900	3,561,544	.....
9,559,195	Denmark	316,570	.....	1,238,898	1,842,481	442,421	.....
79,583,000	Norway	149,167	.....	953,036	1,705,394	96,166	290,985
111,922,650	Sweden	438,090	.....	2,026,330	1,636,201	382,811	124,673
1,283,729,750	Russia	16,160,000	.....	22,770,000	46,432,000	9,800,000	1,700,000
94,463,250	Finland	254,820	.....	997,960	921,745	190,326	30,639
75,047,725	Austria	1,367,023	42,976	7,425,212	5,026,398	2,551,473	979,104
80,963,497	Hungary	2,158,819	33,746	5,279,193	15,076,997	4,443,279	572,951
10,354,500	Switzerland	105,792	.....	992,895	445,400	304,091	374,481
48,849,037	Germany	2,976,277	10,921	14,386,791	22,295,682	6,340,415	2,027,756
8,218,217	Holland	253,393	3,466	1,469,937	898,715	611,004	146,169
7,364,000	Belgium	283,163	11,849	1,242,445	586,097	632,301	197,138
132,262,435	France	2,742,708	705,943	11,721,459	25,035,114	5,755,656	1,794,837
22,771,750	Portugal	79,716	188,640	520,474	2,706,777	776,868	936,869
126,759,000	Spain	680,373	2,319,846	2,967,303	22,468,969	4,351,736	4,531,228
74,830 000	Italy	477,906	718,222	3,489,125	6,984,049	1,553,582	1,090,478
11,903,750	Greece	69,787	93,688	109,904	1,200,000	55,776	1,339,538
30,243,250	Roumania	426,859	6,734	1,842,786	4,786,317	836,944	194,188
	Total Europe	31,573,663	4,136,031	89,678,248	194,026,236	42,686,493	16,931,034

Our number of domestic animals to area one-third that of Europe.

It will be observed that Europe, with an area of 3,777,690 square miles, possesses 379,031,705 head of working and food-producing animals, while the United States, with an area of 3,002,332 square miles, has only 102,395,650.

Our facilities not fully utilized.

The natural facilities for growing and raising stock, and the cost of feeding, are largely in our favor, and there is no doubt but that our country is suffering an immense loss annually for the want of stock to consume the produce of our land, and reduce the waste to a proper condition to be returned to the soil as a fertilizer. In Europe every species of offal is husbanded with rigid care, while with us it is an undeniable fact that the opposite is true. Our agricultural interests will not, indeed cannot, be fully developed until we imitate Europe in raising and feeding more live stock.

Order of the competition.

In the arrangement for competition at the Exposition, it was so classified that foreign or imported stock competed with the French breeds only for the grand prizes offered by the Agricultural Society of France. Excepting two horses, there was no stock from America upon exhibition, but most of the European countries were represented.

Most of the countries in Europe represented.

Division of the exhibitions.

There were three distinct exhibitions during the summer, the first of which comprised cattle, swine, sheep, poultry, and rabbits, and was held from the 5th to the 18th of June. The entries were many in each class, France having much the larger number.

Classes and periods.

CATTLE.

1,700 entries of cattle.

In the cattle department there were 1,700 entries, nearly all of which were in the stalls. Of this number, 1,314 were from France and 386 from other countries. It was, perhaps, the best selection of the bovine races ever gathered together, representing the beef, dairy, and work cattle in various types and generally of superior quality. In so large a collection, as might be expected, there were a number of classes having only a local reputation, and many crosses of the different breeds, which only show the result of an accident in nature, nothing determining what another cross of the same line of breeding might produce. Only the breeds that have established characteristics and value will be noticed in this report.

Short-horns.

Short-horns.

The favorite breed of the 19th century.

The most widely known and, by general consent, the favorite breed of the nineteenth century for all purposes is the Durham, better known as the improved short-horn race. This race of English cattle, which has been imported and is

Cattle.

Short-horns.

now the most numerous of any distinct breed in our country, about which so much has been written, and in which so much capital is invested, has so greatly increased the value of our stock that it would appear unnecessary here to say a word about them, further than that they were honored by being placed first on the list in the catalogue, and being a foreign breed, all in the class competed.

The prominent breed at the Exposition.

118 entries.

There were 118 entries, 41 of which were from the British Isles, and represented the most noted cattle-breeders of that country, among whom were Her Majesty Queen Victoria, Lady Pigot, the Earl of Bective, George Fox, the Marquis of Exeter, Robert Bruce, and John Kersley Fowler, of England, and Humphrey Smith and Benjamin Hannon, of Ireland.

Names of exhibitors.

The British short-horns not superior to our own.

As a lot, the British exhibit was a presentation of good specimens of the race, but did not, in my opinion, possess superior merits to the same breed of cattle often exhibited in our own country at our agricultural fairs. The only noticeable difference consisted in a heavier coat of hair, which no doubt results from the cool, moist climate.

Disappointment of the English breeders.

Quarantine.

The English exhibitors were disappointed in the result of their competition with the short-horns bred on the Continent, and claimed that the rules adopted by the government, which forbade their stock returning home without a quarantine of 14 days (to guard against importation of disease), prevented them from bringing their best animals; but it is not reasonable to suppose that the breeders named would risk their reputation by taking inferior specimens to such an exhibition. That they were fairly matched and really beaten by their own breed of stock, as bred by another people, was true, however unpleasant it may be to acknowledge the fact. It is evident that the time when English breeders of these fine cattle shall enjoy the revenue of a monopoly in breeding and exporting at fabulous figures is at an end. The United States can readily compete with them in numbers and quality, and at greatly reduced prices, and this exhibition shows that France and Western Europe are in the same condition.

Matched and beaten by foreign breeders.

The United States ready to compete.

Development of the agricultural interests of France.

Governmental aid.

During the past half century France has made very great progress in developing her agricultural resources, and in no department have her efforts been more productive of good results than in the improvement of live stock. This has been aided and fostered by the government, through the Minister of Agriculture, in creating and maintaining breeding establishments in which imported foreign breeds have been tested and acclimated, and many native races thereby greatly improved. Thus, at the present time we find in France nearly

all the improved races of English stock, as well as those of other neighboring countries, while she still possesses a number of well-defined races of her own that are admirably adapted to the districts where raised, if not worthy of still wider recognition. *Cattle.*

Short-horns were first officially introduced into France in 1838. The French herd-book, of which eight volumes have been published, shows that 19,000 males and females have been used as breeders since that time, and it was generally conceded that those on exhibition were more uniform in type, more even in form and size, than those of the English exhibit; but, in my opinion, it is inbreeding that has produced this result, and at the same time has reduced the average size of the animals of the breed. Introduction of the short-horns into France. French herd-books.

French authors frankly acknowledge the superiority of the short-horn blood, and admit that no cattle are bred or have been imported into France that equal them in the great desiderata of early maturity and aptness to fatten in districts where there are rich pastures. The increase and popularity of the breed for beef-producing purposes in the country is wonderful. One enthusiastic writer asserts that the short-horns and their crosses are indispensable to the beef-producing interests of France. Some very superior cross-bred short-horns were on exhibition, to show how well they crossed with different breeds, and the same results were apparent there as are found in every instance, viz, the improvement of the breed with which the short-horn was mated. Recognition in France of the superiority of the short-horn breed.

Hereford cattle. Hereford cattle.

Next in order in the English breeds was the Hereford, which was represented by only two animals, a three-year-old bull, exhibited by Her Majesty Queen Victoria, and a yearling heifer, by J. Hewer, of Hereford, England. The Hereford is supposed to be an aboriginal race, indigenous to the county in England from which it takes it name. In the early part of the present century these cattle carried off more premiums at the great fat-stock shows than any other breed, but for many years they seem to have been giving way in these contests to the more favored short-horn. Originally they were of diversified colors; then by breeding were transformed to white face and body of red and white, which has been again modified until it has reached the present standard, which is white face, throat, chest, udder, dewlap, lower part of the body and legs, and tip of tail, other parts being a brown-red. The hair has a tendency to curl. The Decrease of popularity. Color characteristics.

Cattle.

Herefords.

two animals on exhibition were superior in quality, and much resembled the short-horn in form. This breed of cattle, if ever imported into France, failed to give satisfaction, as there is no mention made of them by writers or any traces of the animal; yet they are not without friends in their own country or in ours, where they have been on long trial and are noted for their placid disposition and excellent grazing and feeding qualities.

Not known in France.

Devons.

Devons.

The Devon is one of the oldest breeds in England, and is a great favorite in the county from which it derives its name and in counties adjoining. It is a middle-horned breed, having an excellent constitution, great aptitude to fatten, and its meat is first-class. The milk is rich, and as working cattle they are much liked, owing to their sprightly step. The color is a pure dark red, the hair silky, and the skin of a mellow quality.

Quality and characteristics.

Long-horns.

Long-horns.

The long-horn belongs to the midland counties of England. The horns curve forward and downward, so as sometimes to touch the cheek. The coat is good and the back straight, the color various—dark red, brindled, pied, with a white streak along the spine. The breed has sunk in estimation, on account of the superiority of the Durham, which may be called the fashionable breed, and certainly deserves the lead, from its intrinsic and numerous good qualities.

Characteristics.

Superseded by the short-horns.

Sussex cattle.

Sussex cattle.

The Sussex cattle are noted for working qualities, but, as with us, they are largely superseded by horses. They are a deep red, but have larger horns, heads, and bones than the Devon.

West Highland.

West Highland.

The West Highland, or Kyloes, of Scotland, might be suitable cattle for the mountainous districts of our country, but, yielding all the good qualities claimed for them, their rough appearance will forever keep them from being favorites with our people, and the same might be said of the small Welsh cattle. The Highlanders, however, have excellent grazing qualities, and their meat is of the very finest order. The color varies.

Rough mountain breed.

POLLED CATTLE.

Polled cattle.

The polled Suffolk, Galloway, and Angus or Aberdeen cattle form another class.

Suffolk cattle.

Suffolks.

An old breed of excellent quality for dairy.

The Suffolks have an early history in the county from which they take their name. They not only possess excellent dairy qualities, but they are a very heavy-bodied cattle, with smooth forms and deep flesh. They are noted for their hardy constitution and docile disposition. A thick, mellow hide, well covered with fine, red hair, enables them to endure a low temperature. In the northern portions of our country, where the winters are severe, this breed of cattle would be a valuable addition to our stock. The beef is excellent. They are now being bred to a red color, with certain white markings.

Worthy of introduction into America.

Galloway.

Galloways.

The Galloways do not differ much in size from the Suffolk. They are not so smooth in form, have larger bones, long, coarse hair, hide hard to the touch. The whole appearance of the animal indicates a slow feeder. The color is jet black; the constitution hardy, adapted to the cold, moist climate of Scotland. They are not adapted to dairy purposes.

Angus or Aberdeen.

Angus or Aberdeen.

Origin.

The Angus, or Aberdeen, is a name of more recent date given to a race of cattle supposed to have descended from what were formerly termed "Angus Doddies," or Aberdeen Hummlies. These cattle are what may be termed a new breed, produced by careful selecting and breeding to obtain a definite result.

As all breeds or different forms in the same race of our domestic animals are the result of the natural surroundings and care in mating and keeping them, it follows as a natural sequence that the field for progress in that direction is still open, and it is no real cause for surprise that a group of six animals of this new breed should carry off the highest honors of the exhibition, nor does it establish the fact of the superiority of the breed in a general sense. There were but 15 entries, and every animal was a good one, but there was no evidence of the number from which they were

The highest honors carried off by this new breed.

Cattle.

selected or how great was the percentage rejected as inferior. Yet it is plain that if the same system which produced this lot is adhered to, in time the standard can be perfectly established in the breed.

The Angus or Aberdeen cattle exhibited by W. McCombie Tillyfour.

This is not an accidental success, but for a number of years they have been attracting notice at the different exhibitions in their own country. On this occasion the grand prize of honor for foreign cattle was given to the group owned by William McCombie Tillyfour, Aberdeen, Scotland. The Agricultural Society of France offered a prize of 2,500 fr. for the best group of beef-producing cattle in the whole Exposition, all the members of the different juries acting together in making the award. That prize was also given to the same group of cattle. It was evident that they had long been in preparation for the occasion, by their high condition of flesh and the care with which they had been prepared. Their color, like the Galloway, is black, but the form is blocky, like the short-horn. The hair is soft and fine, the hide thick and mellow; the bones, in proportion to the size of the animal, are small; the joints smooth, and the flesh well laid on in the most valuable portions of the carcass; the shoulders are smooth, the crops and loins wide and deep, the quarters long and full. The owner claimed for them a very docile disposition, early maturity, and aptness to fatten, but not up to the average in dairy qualities, and, further, that a cross between them and the short-horn very much improved their grazing qualities.

Color and other characteristics.

Ayrshire.

Ayrshire.

There were only seven entries of the Ayrshires from England and Scotland. They were fine specimens of that excellent race of dairy cattle, but did not show superior quality over those that have been imported into the United States.

Color and qualities.

The Ayrshires are a rather small breed, the color frequently red, or brown and white in large patches, or all red and brown, or even sometimes black and white. The horns are fine, curve upward, and are placed wide apart at their bases. The neck is straight from the head toward the top of the shoulders, which are very thin on top. The back is straight; the body is wider and deeper as it approaches the hind quarters. The bone is small, legs short, the eye mild, the udder very large, and the disposition docile.

Jerseys and Guernseys.

Cattle. Jerseys, etc.

These cattle, long known under the general name of *Alderneys*, are probably the descendants of Norman or Breton cattle, but have attained a type of their own, with two varieties now distinguished.

Origin.

The Jersey cow is essentially a dairy animal, and is remarkable for the neatness of its form, slender frame, deer-like head, gentleness, and richness of milk. The symmetry which the Jersey cow should possess is determined by a scale of points which has been drawn up by the Royal Jersey Agricultural Society. The milking qualities take the greatest number of points.

Characteristics of the Jersey cow.

The Guernsey cow is longer, coarser, and almost uniformly red and white. It is a better meat animal and inferior to the Jersey for the dairy. The muzzle, the skin around the eyes, and the tips of the horns are yellow or brownish in the Guernsey, black in the Jersey.

The Guernsey cow.

The breeds have many points of resemblance, and some individuals of each may be easily confounded.

The breeds had but few representatives in Paris. The best specimen was bred in Ireland.

Kerry.

Kerry.

The little Kerry cattle of Ireland were the liliputian race of the show. A neatly formed head, upturned horns, lively and expressive eyes, and a body but little more than three feet high, if not very smooth and round, made them attractive. The Kerry is sometimes called the "poor man's cow," from its moderate size, hardiness, good milking qualities, and docility. There were 14 Kerry cattle in the stalls, all black.

The small dairy cattle of Ireland.

Hollandaise or Holstein.

Hollandaise or Holstein.

Hollandaise is the name under which the Dutch cattle were exhibited, but they are imported into this country under the traditional name of Holstein, derived from the idea that centuries ago they came from Schleswig-Holstein. There is no proof of such being the case, and they have a long history connected with them in Northern Holland. The earliest history of the short-horns induces the belief that the Hollandaise cattle were taken to England and became the progenitors of the famous English breed.

The probable progenitors of the short-horns.

The exhibition of the Hollandaise race was very fine, there being 53 head in the stalls. These cattle, in natural formation, are not smooth animals, but when well kept carry

53 animals exhibited.

Cattle.

Holstein.

sufficient flesh to give a general form not unpleasant to the eye; such was the case with those on exhibition. The established type of the breed is above the medium height; legs long, body large and coarse, projecting haunches, and drooping rump; head rather long and narrow, short horns, neck thin; ribs long, flanks light, and remarkably fine udder and escutcheon. The hair is very fine, the hide soft, and the color usually black and white, though sometimes all black or white.

Characteristics.

It is admitted that they are large consumers of food; but it is also claimed that they fatten readily when off their milk. They are great milkers. It is not an unusual case for these cows to give from thirty to thirty-five quarts of milk a day, from which is made the celebrated Dutch cheese, known the world over. The skeleton-like appearance of these cattle, some of which have been imported into our country, tends in a great degree to bar their general introduction. For this gaunt appearance their owners are mainly responsible, by depriving them of food. These cattle can be made attractive to the eye, as well as profitable to the owner, by proper feed and care.

Quality.

Switz.

The Switz race.

Color and size.

The Swiss cattle are mostly of a dark-brown color on the body, with a light mouse-colored stripe on the upper line. They are generally above the medium size, with square and compact bodies, heads large and coarse, thick necks, with heavy, hanging dewlaps. With the improvement of agriculture in Switzerland, which has been very great in recent years, the improvement of stock has kept pace. Many of the objectionable points in the cattle have been bred out of them by selection. They still retain their claim as a superior race for the dairy, and furnish one of the greatest sources of revenue to the country. The ox, and very often the cow, is used for doing the work on the farm. They receive the kindest treatment from their owners, and, in consequence, they are unusually docile in disposition. From the practice of wearing bells it is said they evince a love for music, giving rise to the country saying that a dairy-maid with a fine musical voice will increase the quantity of milk yielded by the cows in the dairy. Most of the cattle in the stalls had premium bells hanging by them—the trophies won in local competition at home fairs. These bells are of the finest metal and weigh from 15 to 20 lbs. each. These cattle have fine and muscular limbs, with feet apparently as hard as iron, and well adapted to the

Breed improved of late.

Great dairy breed.

Treatment and disposition.

Prize bells.

steep, stony regions of their native country. Their milk, though not so great in quantity, is like that of the Channel Island cattle—very rich in cheese and butter qualities. The Swiss cheese is among the finest made in Europe, and finds a ready export sale. Combining these excellent qualities with that of great hardiness and a fair beef-producing structure, they would, unquestionably, be a valuable cattle in the mountainous districts of our country, especially where but little grain food is grown.

Cattle.

Switz.

Flemish cattle.

Flemish.

The Flemish cattle have, without doubt, a common origin with the Hollandaise and other races that are found on the coast of the North Sea. Although this race in the past has often been crossed with the Holland race, the Flemish of to-day has little or none of the large and strong characteristics of that race. Lately they have been bred exclusively for the purpose of developing the milking qualities, at the sacrifice of beef. They are mostly of a very dark-red color, thin in flesh, high on legs, slender and angular in form, very flat sides, and drooping haunches. With all these apparent defects, they evidently possess the power of transforming the products of the soil they feed on into milk of superior quality. They are kept on the soiling plan, and are not allowed to go to pasture. By this principle a greater number can be kept, and more manure gathered to return to the land. Only the choicest males are kept for use as breeders, the remainder slaughtered when young. By thus selecting for a specific type, there was a very strong family resemblance among the 85 animals on exhibition. The appearance of these cattle did not compare favorably with other milking breeds on exhibition, and I commend the race with no expectation of it being favorably received in our country. Yet the jury awarded to a group of them the grand prize of 2,500 fr. offered by the Agricultural Society of France for the best group of milking cattle at the Exposition. I was assured by other visitors that I was not alone in the opinion that the prize was incorrectly placed.

Dairy cattle.

Quality.

Soiled, not pastured.

Awarded the prize for the best group of milking cattle.

Danish cattle.

Danish.

The Danish cattle exhibited were of a deep-red color, of medium size, and the only particular value claimed for them was milking qualities. They were in such an extremely low condition of flesh that they were unfit for exhibition. No matter how superior they may be for the specific pur-

In poor order.

Cattle. Danish.

pose for which exhibited, they were more the objects of pity to the eye of the visitor than credit to the country or people that placed them on exhibition. It seems a difficult task to convince people that a living skeleton can be neither profitable nor creditable to the owner under any circumstances.

Italian.

Italian cattle.

Coarse and bony.

Northern Italy exhibited only working cattle. They are tall, coarse in bone, of unsightly appearance, and their form bespoke a life of privation, toil, and exposure which has been their lot for generations, until the last ray of intelligence and ambition seems obliterated.

French breeds.

FRENCH BREEDS OF CATTLE.

Established and well-marked local types.

The cattle of France are very much diversified in races or breeds, which have each a local origin, and must have long been bred in this manner to establish such distinct types. There does not appear to be any traffic in live stock between the different parts of the country; no mingling or exchanging, as with us. The agriculturists or peasantry of France (I might say Continental Europe) are not a traveling people, and are uninformed as to what is taking place outside of their immediate vicinity. If it were not for the plan adopted by government of encouraging the improvement of stock, very little enterprise outside of each narrow and restricted circle would be exercised. Thus, we find in the

17 different races exhibited.

French division of the catalogue what they call 17 different races of cattle, named after as many different provinces or localities. A number of them have the form of what might be termed distinct breeds, while others vary but little except in name. One peculiarity of these cattle is the al-

Exactness of form and color in the individuals of each race.

most wonderful exactness of color and form established in each different race, which can only be produced by a long line of breeding and selecting for that purpose; but there is no history, no herd-book of any of them, to show how long it has taken to do this. I shall only notice the most defined and noted of these breeds, stating the objects for which they have been produced.

Normandy.

Normandy cattle.

Milch cattle.

The most noted dairy breed of France is the Normandy race, which prevails in the departments of Manche and Calvados, in Normandy. In former times this breed was valued for its yield of milk, but the animals being large and coarse consumed a large amount of food in proportion to the prod-

uct. Since the introduction of the short-horns into that country they have been crossed with that breed, which has greatly improved their form and aptness to fatten, without injuring the milking qualities of the race. Hence, we find the Norman, as exhibited, a large and tolerably well-rounded animal. The original color remains unchanged by the introduction of the new blood.

Cattle.

Normandy cattle improved by crossing with short-horns.

There were 150 animals of this breed on exhibition, and every one them was of a beautiful mixed-brindle color, which, together with their large forms and fine condition of flesh, made them, as a lot, a very attractive sight to the lover of good stock. The prominent points of the breed are, head short, face broad, eyes full but small, expression mild, horns wax-color, and as the animal advances in age they are quite long and circle upward; body long, haunches wide and rump straight, tail light and long, thighs thin and wide apart, giving room for a large and finely formed udder and teats.

An attractive lot of 150 animals of even color and good condition

Characteristics.

The Normans compare favorably with the Holsteins for the dairy, and are more regular in form and pleasing to the eye. They fully equal them in hardiness of constitution. Their color is more acceptable to our tastes, and, upon the whole, I believe they would give good satisfaction to our people were they imported into this country. With the improvement of the short-horn cross they are certainly a better animal to fatten, and would give better returns in beef when no longer serviceable in the dairy.

Worthy of being imported into America.

Breton race.

Breton.

These animals constitute a small race found in the western part of France, the history of which may almost be termed ancient. They may truly be called the poor man's cow, from their ability to subsist on a small amount of poor food, and yet give a larger amount of milk than almost any other race under similar keep. To those farmers and stock-growers in our own country who believe and advocate low feeding to produce superior stock, and are always pointing to the great danger from overfeeding, this race of cattle can be highly recommended. In them they will find a race trained for centuries in consonance with these ideas of keeping. They are of a similar form to the Channel Island cattle, but larger. They are generally of a black and white color, with short and broad heads, horns white at the base, tipped with black, muzzles black, eyes very black and docile in expression. The body is muscular, bony, and rough; limbs fine, feet small. With the improvement of agricult-

A small breed of eastern France.

Characteristics.

Cattle. Breton.

ure in their country, the better breeds of cattle are being introduced and crossed on them, and it will not be long until the race in its purity will exist only in history. The cross of the short-horns seems to give the best satisfaction, by increasing the size and feeding qualities, but they require better feed and care, as they do not retain the self-sustaining powers so well as the original breed.

Charolaise.

Charolaise race.

A celebrated race in France, of milk-white color and evenly-established form.

This race of cattle is one of the most ancient, finest, and best known in France. Their milk-white color and similarity of form is really a natural wonder. Of all the breeds I have ever examined none ever impressed me with such a distinctive similarity as did these. They take their name from Charolles, in the department of Saône, and have a well-authenticated history since 1789. Since that time they have spread through a considerable portion of the country, and great care is taken to keep the breed pure. The short-horns have been crossed on them with varied results, always increasing their milking qualities and aptness to fatten when on good food, but injuring the quality of the oxen for work and the value of the animal for grazing on the pastures of the country. For the purpose of testing this cross, the first short-horn bulls were imported into France by Brière d'Azy in 1825.

Care in breeding.

Crossed with British short-horns.

That importation was made under the most favorable circumstances, as a skillful English herdsman accompanied these animals, and continued in charge of them. Although not conceded by the breeders of this race of cattle *now*, yet from the great similarity between them and the short-horns it is evident that the cross made at that time was the foundation of the present form of the race, which may thus be described: A short and broad head; wide, rosy muzzle; squarely formed mouth; eyes large and prominent; forehead broad, with an expression of kindness and patience on the countenance; horns short and wax-colored, standing well forward; neck fine at the head and arching to the body on the top, and filling out well on the sides to the shoulder points. The shoulders are slanting and smooth; crops well filled; fore-rib long and rounded, giving abundance of room for heart and lungs. The back is broad and straight; loins level and wide; the quarter smooth and very round. The twist is full, but not let down as far as it should be. The lower limbs are fine and muscular, and the hoofs hard and well suited for traveling. This is pre-eminently the beef breed of France. The quality, however, does not rank as high as

The effect of the cross.

Characteristics of the present Charolaise cattle.

some other, as the meat is said to lack juiciness. The hair is fine and hide hard. They are highly valued as work cattle, possessing great strength and endurance, and surpassing the average ox in speed. At maturity the ox often weighs 2,500 or 3,000 lbs. I saw them at work with the deep subsoil plows, at the trial of these implements, and their power of draft exceeded the heavy draft-horse and the the speed was fully equal to his.

Cattle.

Working quality.

Charolaise.

The 65 animals on exhibition, though of different ages and sizes, were all a pure white, and all of the same symmetrical form, which considerations made them the most attractive lot of cattle on exhibition, and as a mark of excellence the jury awarded them the grand prize of honor as the best for general use among the native races. Although their color (white) and inferiority as dairy animals would be against them in this country, their meat-producing, as well as early-maturing, qualities would commend them to favorable consideration.

The most attractive lot on exhibition.

Grand prize as the best native race.

Limousine race.

Limousine.

This race of cattle is of a fine form, above the average size, and uniformly of a dark-red color. They have a very intelligent-looking head, a smooth and regularly formed body. Those on exhibition, 70 in number, were all of the same type, and, if fair representatives of the race, were, like other breeds mentioned, a curiosity to see.

Color and characteristics.

To the observer it would seem that in all the French races selected for exhibition the individuals in a group bore a striking similarity in form and color. The cattle of no other country represented showed so much evenness in these respects. It is doubtful, however, whether in their native districts this marked uniformity would be so prominent.

Evenness of color and shape.

This race has a form calculated to furnish a large percentage of excellent beef, but their greatest claim to distinction is that of work cattle, and the least that of dairy qualities. Both sexes are taught to work when young, and cattle are the only animals of labor used in their part of the country. It is admitted that they do not possess the great strength of the Charolaise, but they are more tractable and docile, enduring greater fatigue and subsisting on a less amount as well as a coarser quality of food.

Qualities.

To a group of this race was awarded the grand prize of 2,500 fr. offered by the Agricultural Society of France for the best cattle for labor.

The grand prize for working cattle.

Cattle. Garonnaise.

Garonnaise race.

The Garonnaise is a widely distributed race. The cattle have fine forms, are all of a light-red color, and occupy the valley of Garonne River for more than 500 miles between Toulouse and Bordeaux.

Bazadaise.

Bazadaise cattle.

The Bazadaise are low, heavy-bodied cattle, similar in many respects to the Swiss, being of the same color—dark gray or brown—and their appearance indicates great hardiness of constitution.

Parthenaise.

Parthenaise race.

The Parthenaise race is found in Vendée. They are mixed in color, being red and gray, and are claimed to be superior milkers, but are by no means attractive in appearance.

Salers.

Salers race.

The Salers, a numerous race, possesses many good qualities. They are of a deep-red color, somewhat resembling the English Devons, though larger and not so smooth in form. Their uniformity in color shows a long line of breeding.

General considerations on French cattle.

I might continue on through the list of French cattle exhibited, and notice the different points of the races, but having described what they consider their best breeds for beef, the dairy, and labor, the others would differ only in minor types, each claiming, and no doubt possessing, real value for the purpose for which it is bred. All the races

Breeding and management.

show that the French people for a long time have given great attention to the improvement of horned stock, and the cattle on exhibition and those seen in different parts of the country attest that the masses of their cattle are better than ours, receive more kind treatment, better care, and better feed. The same rigid system of economy that is practiced in the cultivation of the soil is applied to the growing and keeping of their stock. One animal bred for the purpose needed, and well cared for, is more profitable than two accidentally bred and half fed can be.

The finest exhibition of distinct races on record.

There never have been so many distinct races of the bovine species, or so many superior animals of the races assembled together, as at this exhibition. This is no doubt due to the fact that more effort has been given to the improvement of the species lately than ever before, and that

the wide classification adopted and the liberal premiums offered on this occasion brought out a more general exhibit than any former exhibition. *Cattle.*

In the cattle department 130 cash prizes were offered for foreign cattle; the sum total of these prizes was 66,100 fr. For native French cattle 363 cash prizes, amounting to 146,825 fr., and three grand prizes of 2,500 fr. each, making a total of 220,435 fr., or over $42,000. All the prizes in their group were taken in the native races, and nearly all offered in the foreign group. Liberal scale of prizes.

SHEEP. *Sheep.*

The show of sheep was very good, but while many specimens of the best races and varieties were exhibited, there were many others of mere local interest, and neither fine in appearance nor quality. Of the 825 entries there were—

Analysis of the exhibit.

Foreign exhibits:	
Foreign Merinos	13
British breeds	187
Low countries	13
Other foreign breeds	29
French exhibits:	
French Merinos and *Métis-Mérinos*	269
Native long wools	34
Native medium wool	20
Native mountain sheep	48
Race Charmois	24
French-bred Dishleys (Leicester)	49
French-bred Southdowns	42
Crosses and grades	97
Total	825

Merinos. Merinos.

The *Merinos* had the place of honor in the French catalogue. All the foreign entries of this race were from Italy, and the Merino and *Métis-Mérino* included more than one-third of the whole number of sheep exhibited. Métis-Mérinos.

The French Merino, of which there are great numbers, originally came from Spain. They are small in size, of a rather delicate form, with very fine fiber in the fleece. What is termed the American Merino, in our country, is a larger and stronger sheep, derived from the original Spanish stock, and possesses all the merits of the French breed, and the same may be said of that breed exhibited from Northern Italy. Of the native breeds of France but little can be said in their favor. They are mostly local in reputation, and have inferior forms when compared with the new Origin. The American Merino. Inferiority of French native breeds.

Sheep

or improved breeds, and it is evident that they are fast giving way before improvement by crossing.

It does not appear that the sheep-raisers adhere to the same rule as the cattle-breeders to improve the race without losing the original family type; neither have they adopted any of the pure English races as a standard to suit their wants. On the contrary, they have united, by crossing, foreign and native breeds, and built up new ones.

System of crossing adopted by the French.

The long-wool breeds modified by crossing with the New Kent race.

The long-wool sheep of the northern departments are known as Astésienne, Normande, Picarde, and Flamande, named after the old provinces, yet they are the outgrowth of the old Flemish race, modified by a continued use, for thirty or forty years, of English rams of the New Kent race. But the greatest success is to be found in the fine-wool crosses. By crossing the Spanish Merino with these cross-breds natives, they have produced what is now known as the *Métis-Mérino*, a sheep that seems destined to become the most valuable in France.

Origin of the Métis-Mérino.

Its wool and mutton qualities.

They have thus succeeded in retaining the fineness of the Merino wool, as well as increasing the size of the carcass to that of a finely formed mutton sheep, shearing from 12 to 20 lbs. of wool.

The staple.

The staple of the best of the *Métis-Mérinos* is from 4 to 6 inches in length, and comparatively free from the oily substance in the wool of the Spanish Merino, thus securing a much greater percentage of clean wool. The neck is free from the wrinkles of the Merino, the head and face well covered with wool, and the limbs wooled down to the feet. They also retain the aptness of the Merino for thriving well in large flocks, and seem well able to withstand exposure to bad weather. So thoroughly have they combined the good qualities of the pure Merino that they were classed together in the same catalogue, competed for the same prizes, and won a good share of them. The grand prize of 1,500 fr. given by the Agricultural Society of France for the best pen of native-breed mutton sheep was awarded to a branch of this breed known as the Dishley Merino. The name "Dishley" indicates crossing with the Leicesters; the French catalogue indeed speaks of the "New Kent" as a modification of the Kentish or Romney Marsh sheep crossed by the Dishley (Leicester).

Characteristics.

Award of grand prize to the Dishley Merino.

Value of a breed uniting good wool and mutton qualities.

The value of a breed of sheep that unites good mutton qualities and fineness of wool is apparent to all, and as this seems, in a great measure, to have been attained in the *Métis-Mérino* by the French breeders, the breed would be a valuable addition to the sheep interests of our country. If

this Exposition proves suficient to attract the sheep-growers of our country to the value of these animals, and cause them to import a number, I doubt not but their value would soon be appreciated, and our fine wool product be much increased. *Sheep.* Métis-Mérino should be imported.

THE SHEEP OF THE ENGLISH DOWNS. Down sheep.

Southdowns.

England had 39 entries of Southdown sheep, and France 42 of the same breed. It takes the precedence in its class of sheep by right of priority and continued care. The Southdowns of England are in Sussex, the native home of the sheep, 17 of the 39 entries being from that county. Southdowns retain their old supremacy.

The Southdowns exhibited by Lord Walsingham, of Merton Hall, Norfolk, showed their excellence and maintained the high honor heretofore won as a mutton sheep, by winning the grand prize of 1,500 fr. offered by the Agricultural Society of France for the best pen of foreign sheep for the butcher; also the grand prize of honor for best pen of sheep of foreign races. Lord Walsingham's exhibit. Grand prize.

The symmetry of the Southdown sheep is proverbial. The bone is small, the body thick and cylindrical, the ears wide apart. The ears and forehead are well covered with wool, which forms a protection from the fly. The eye is full, bright, and quick; the chest wide, deep and projecting; the back flat to the tail, which is set on high; the hind legs are full on the insides and wide apart. Symmetry and characteristics

The wool is short, close, curly, and fine, of excellent quality; it is the shortest staple wool of Great Britain. The wool.

The mutton is of the finest quality, excepting some mountain breeds, such as the Dartmoor, the Welsh mountain sheep, and the Black-faced mountain sheep of Scotland, which feed on aromatic herbs and young shoots of heath, giving a venison taste to the meat. The mutton.

The other Down sheep of England were classed together in the third category of the French catalouge, viz, the Shropshire, Hampshire, and Oxfordshire Down. There were 41 foreign entries, all from England, excepting 4, which were from Belgium.

Shropshire Downs. Shropshire Downs.

The Shropshire Down is the favorite breed in the midland counties of England, and from the dark face and legs are often thought to be allied to the Southdown. They are, however, a larger sheep, and yield a heavier fleece and Larger carcass and heavier fleece.

Sheep.

of a finer staple than that breed. They are also much prized for mutton.

Shropshires.

The Southdowns thrive best on hilly land, while the Shropshire Down does well on low or flat land, which ought to recommend this breed as suitable for the prairies

Adaptation.

of our Western States. They are hardy, apt to fatten, prolific, and are good mothers.

Hampshires.

Hampshire Downs.

Habitat.

These sheep occupy the rolling downs on the chalk formation of Hampshire and Wiltshire. They are larger and stouter than the Southdowns, which otherwise they much

Characteristics.

resemble. They have attained stable breed characteristics, the result of careful crossing the Southdown upon the old Wiltshire sheep, and are now a favorite breed in six counties of England.

Fleece and other qualities.

The fleece is of average weight and quality, of middle staple, but inferior to the Southdown.

They are prolific, hardy, and good mothers.

Oxfordshires.

Oxford Down, or Oxfordshire.

Coarser grade.

This is a still coarser grade of wool and larger breed. It possesses the characteristics of a combination of the Cotswolds and the sheep of the Hampshire and Sussex Downs,

Heavier carcass.

from an admixture of which breeds they are doubtless derived, but by a uniformity of type having been adhered to, they have now become a recognized breed.

Adaptation.

They succeed in England on mixed soils and feed on the green crops of arable land better than on sheep-runs. They are prolific, are good mothers, and come early to maturity.

Characteristics.

They are dark in color, poll covered with wool, top-knot on the forehead, legs black.

The fleece is thick, rather long staple, and coarse.

Long-wool and mutton breeds.

LONG-WOOL AND MUTTON BREEDS.

In the long-wool and mutton breeds the English breeders excelled all others, and as a lot these sheep had undoubted superiority over those of other nations.

Leicesters.

Leicester.

Origin.

The Leicesters are of the *Dishley* stock, and are generally known in France under the latter title, the name of the residence of Mr. Bakewell, the great improver of English stock, both cattle and sheep. The Dishley and Southdown are the only English breeds which seem to find favor in

Sheep. Leicesters.

France. Of the French-bred Dishley there were 49 entries and of the Southdown 39 entries; also 3 Shropshire Down. Of the cross-breeds there were 56 entries of Dishley crosses and 13 Southdown crosses. These were interbred with numerous native French races—Normande, Artésienne, Berrichone, Cauchoise, Mauchamp, Lauraguaise. In fact, of the 97 cross-bred entries there were but 28 in which the Dishley or Southdown were not mingled, and of these 14 were crossed with Merinos, and 7 were Algerian sheep, origin not stated; the remaining 7 being crosses of French native breeds on both sides.

Extensive crossing in France.

The Leicester breed is widely known in the United States, but it is easier to raise choice specimens and little bunches of sheep than it is to succeed with them in flocks. They succeed on land where they can be well fed, and are adapted to highly cultivated soils, but not to ranging.

The Leicesters in the United States.

They are more symmetrical but not so large as the Lincolns, are early to mature, a most valuable mutton sheep, with a great facility for laying on fat when they are pampered. The bone is fine.

Compared with the Lincolns.

The fleece is classed in England as moderately long, though it strikes the ordinary observer in the United States as very long, as it is frequently penned near the Merinos and Southdowns at our fairs. The wool is a combing wool, is bright, coarse, and adapted for lusters, serges, and carpets.

The fleece.

The shape of the animal is admirable, the back being broad and straight and the chest deep and wide. The head and ears are apt to be hairy. The ears are long and thin, the eyes prominent. No sheep has been so largely used for improving other breeds.

Shape and appearance.

There were 29 entries of English Leicesters, besides the 49 French-bred animals of the same breed previously referred to. Also 5 entries of the New Kent, the sheep of the Romney Marsh improved by admixture of the Leicester, and which contributed to the present *Métis-Mérino* stock, the most prominent breed at the present time in France, as previously referred to.

Entries.

Lincolns.

Lincolns.

The Lincolns produce a heavier fleece than either the Leicesters or Cotswolds. They are hardy, succeed well on wet soils, which are so common in their native country.

The fleece.

Habitat.

Like the Cotswolds, they are very large. Some specimens of these breeds at the Exposition weighed over 400 lbs. each.

Large size.

Sheep.
Lincolns.

The Lincolns have good symmetry and are early to mature, having much similarity to the Leicesters of the adjoining county.

The wool is long, bright, and coarse.

There were 26 foreign entries of Lincolns in the show on the Esplanade.

Cotswolds.

Cotswolds.

Origin.

This is a native West of England breed of ancient celebrity. They are abundant in three counties of England, embracing land of superior quality.

Characteristics.

The sheep are hardy, mature early, and have very large frames, the back of fat sheep being surprisingly wide and flat and the rump overhanging. The chest is prominent and wide.

Fleece.

The fleece is heavy; the wool very curly, long, white, and lustrous.

There were 21 foreign entries of Cotswolds in Paris.

Other breeds from:

It would not be profitable to speak at length of some other breeds of English, French, Hollandaise and Swiss sheep.

British Islands,

Britain had 10 entries of Cheviots and 10 of Exmoor and Mountain; Scotland and Ireland, 12 entries of Black-faced; Ireland, 7 of Roscommon—the latter the only Irish breed represented.

Low countries,

The Texel and Polder sheep had 14 entries.

France,

The long-wooled French races—Artésienne, Normande, Picarde, Cauchoise, Poitevine, Comtoise, Boulonnaise, Bretonne—had 34 entries.

The French middle-wool races—Solognote, Languedocienne, Crevant, Berrichonne, Champenoise—had 20 entries.

The French mountain sheep, of 12 stated races, not needful to enumerate, had 48 entries.

The Charmoise race, which is cross between the New Kent and the native Berrichonne, has attained some celebrity since 1840. It is remarkable for early maturity and facility in fattening. It is of medium size, hornless, fine-boned, wide loins, wide and deep chest. There were 24 entries.

and other countries.

The Swiss, Spanish, Algerine, Italian, Savoyard, and Belgian sheep were but few in number.

Great extent of European sheep husbandry.

The raising of sheep is much more general among agriculturists in Europe than in the United States.

They outnumber us in animals more than five to one, and this in the face of the fact, before mentioned, that in the

United States the facilities for growing and feeding them are greater than in France. *Sheep*

In this department at the Exhibition the prizes offered were large, attracting general attention. No doubt it was so arranged for the purpose of stimulating greater improvement.

To foreign-bred animals there were offered 100 cash prizes, the total value of which was 32,450 fr.; to native races and cross-breeds, 90 prizes, amounting to 24,350 fr., the value of all being over $11,000. Liberal scale of awards.

No sheep were exhibited from America.

SWINE. *Swine.*

The exhibition in this class of stock was not equal in quantity or quality to what may be seen annually at the leading fairs in the United States. True, the English breeders were there with choice specimens of their Berkshire, Yorkshire, Lincolnshires, Middlesex, Sussex, and Suffolk breeds, but we have them all in our own country in as well-developed forms, in every particular, as they. No citizen of the United States who is familiar with this class of stock at home need longer turn to Europe with the expectation of finding it in more perfect form. It is also true that from England we have brought most of our improved breeds, and have thus secured the benefit of a long series of years' experience by the breeders there. Superiority of the English breeds; now as well grown in the United States.

In the southern countries of Europe there has long existed a black and almost hairless breed known by the name of Neapolitan, which is of small size, with a round, smooth body, and very prolific. This race was taken to England and crossed with the coarse native hog, and produced the Berkshire and other dark-colored breeds; yet it is said that none of the breeds thus formed equals in fineness the flesh of the original race. The Neapolitan crossed with the native English breed.

The little white Chinese race, with legs not over a finger's length, a handsome little head, with ears about the size of an apple-leaf, standing erect like a squirrel's, and not weighing over one hundred pounds at maturity, was taken to England as the bases of their white races. The cross of the Chinese breed.

In Normandy, France, they have a large race, the body of which is long and thin, heavy hanging ears, and a long and well-tapered snout. The only good qualification I could discover in the race is their adaptability for subsoiling. The Norman hog.

In the Limousine they have a very good race of swine. In form they are of medium size, have small, erect ears, fine The Limousine hog.

Swine.

limbs, and stand well on their feet. They are peculiarly marked in color—white in the middle portion of the body, black fore and aft.

The improvement in French swine but recent.

In France, and in fact throughout the Continent generally, there appears to have been little attention given to the improvement of the swine until recently; consequently, we

The wild boar.

find many of them but little in advance of the wild hog, which is to be seen plentifully in the shambles of Paris, appearing as game, along with venison.

Importation of English breeds.

The people of France have recently imported many of the improved English breeds, and much interest is now manifested in the improvement of the swine by crossing. A number of pens of these crosses in the French section showed great success, as also a fine lot of English breeds, purely bred and of much excellence.

Prizes of honor to the Middlesex breed,

The prize of honor for native-bred swine and the grand prize of 1,000 fr. offered by the Agricultural Society of France for the best pen of hogs for the butcher was given to a lot of the Middlesex breed, bred and exhibited by the French breeder M. Poisson.

The prize of honor for foreign breeds was awarded to G.

and the Suffolk.

M. Sexton, of Ipswich, Suffolk, England, on a pen of Suffolks. In making the awards the juries seemed to favor the white hog in preference to the black.

Cattle and hogs in the United States, means of concentrating our coarser products.

With us cattle and hogs seem to sustain the relation of immense manufactories, transforming a large portion of the vast corn crops of the Western States into a more concentrated form of human food for the markets of the world, and the natural adaptation of both to our soil and climate does and will enable us to produce the result at a much less cost than in Europe, and our exports in that direction in future years must be largely increased.

Value of superior breeds.

Hence, it follows that the more we improve our stock and definitely fix the form and breeds that will produce the best returns for the amount consumed in the shortest space of time, the greater will be our profit on the investment.

That we have made rapid strides in this direction of late years our foreign trade abundantly proves; however, there is still much to be done in this direction before the greatest possible avails of this industry shall be realized.

Poultry.

POULTRY.

Chickens.

Chickens.

The exhibition of poultry was very full in varieties and collectively very fine.

1,461 entries.

Of chickens there were 1,461 entries. I did not notice

any species that are not raised in our country, and those that are highly prized here were most numerous at the Exposition. *Poultry.*

There were, of Crèvecœur, 165 entries; Houdans, 158; La Flèche, 124; Gray Dorkings, 87; Spangled Hamburgs, 85; Brahma-Pootras, 95; Buff Cochins, 91; White Cochins, 39; Black Cochins, 35; Black Spanish, 48; and of the game varieties, 77, besides many others of less celebrity. Breeds exhibited.

There were a great many cross-bred fowls, but they are not yet well enough defined to be classed as distinct breeds. The growing of poultry receives great attention throughout France, and with the French, more than any other people, it is often made a specific occupation and one of much profit. Cross-breeds.

In this class of stock, where the rules of judging perfection in the varieties are often decided by the color or shape of a particular feather, I will not venture an opinion further than that the standard of excellence in each class was more generally approached than is often done at such expositions. Standard of excellence.

Turkeys. Turkeys.

There were 91 entries of turkeys. They were of varied colors and forms; but the most attractive group was that exhibited by Miss King, of King's County, Ireland, which consisted of eight very large and finely colored bronze turkeys, bred from stock exported from the United States. Bronze.

The other varieties were nearly all either black or white, and of less size.

Geese. Geese.

Of geese there were 50 entries, which were nearly all of the large Gray Toulouse—now common in our own country.

Ducks. Ducks.

There was a fine exhibition of ducks, being 137 entries, which included Aylesbury, Rouen, and the Labrador species. They were all of large size and perfect types of the different breeds.

Pigeons. Pigeons.

There were 516 pairs of pigeons, of which 128 pairs were of the carrier species, the others being of various breeds and colors and mostly of large size.

Rabbits. Rabbits.

Three hundred and ninety-four rabbits, mostly of the long-eared species, were comprised in this Exhibition.

Dogs.

DOGS.

The exhibition of the canine species was held in the stalls of the cattle-sheds during the first week of July. I am at a loss what to say of this class of animals to the people of our country—a country where the dog is scarcely recognized as property—where not even a right to life is guaranteed to him, and where he is usually treated as a scavenger, a thief, and a sheep-murderer.

The uses and value of the dog in Europe.

A very different estimate is formed of him by the people of Europe. In the rural districts dogs are almost everywhere used in tending sheep. It is not an uncommon sight to see an old man or woman who, from age and feebleness of body, is no longer able to obtain a livelihood by hard labor, accompanying a flock, with the intelligent shepherd-dog to keep them from trespassing, and to take them to and from the fold or the pasture. The absence of fences, the pasture strips lying alongside of growing crops of grain, etc., renders this species of care imperative. The use of sporting and hunting dogs is also more common than in most parts of the United States. In some countries the use of powerful and well-trained dogs is necessary as a protection against wolves, and against foxes in the lambing season.

800 entries.

At this Exhibition there were nearly 800 specimens of the canine race brought together, comprising almost every variety that is to be found in the different parts of the world, thus presenting a great many different types, forms, and colors of the animal.

Mastiff.

The Mastiff was represented by 14 entries, all owned in England and France. They were of various colors—large and powerful animals, unsocial, brave, and faithful.

Bull-dog.

Of the Bull-dog there were 30 animals exhibited.

Newfoundland.

The Newfoundland dog was not represented at the Exposition, but a species was exhibited from the southwestern coast of France closely resembling them in size, form, and color.

St. Bernard.

The St. Bernard was represented by six animals—three bred in France, two in England, and one in Switzerland. The English-bred ones were apparently larger, had long, shaggy hair, with a very bushy tail, while the French and Swiss representatives were of smooth coat. All were large and powerful animals, with kind dispositions.

Terriers.

There were many of the Terrier species. Of the British

breeds, the Skye Terrier is the most valuable. He is of small size, with long, fine hair, piercing black eyes, and very active. *Dogs.*

One specimen, exhibited by the Prince of Wales, was covered with steel-gray hair, from 6 to 8 inches long, over his entire body. This animal seemed to be the highest type of the breed, from the fact that to it was awarded a gold medal. Terriers.

The English Terrier is a small animal, with short and smooth hair, usually of a black-and-tan color, and much used for unearthing foxes and badgers from their burrows.

Of Pointers, Setters, Retrievers, Spaniels, and other sporting dogs, there were large numbers, comprising all colors. Pointers, setters, etc.

The Spaniel may be called a native of both sides of the Mediterranean Sea, as the earliest history finds it there. Spaniels.

Of the Hound species there were numerous representatives. The Greyhound has a very ancient history on the Eastern Continent, and in form differs much from all other species of dogs. The largest variety is the Scotch Deerhound, of which one specimen exhibited was 31 inches high, had a length of head 13 inches, body 82 inches, with an extension of tail 28 inches. This variety is scarce, and valued very highly for hunting large game. They are all of a blue-gray color. Hounds.

The finest type in form, and said to be of the greatest speed, is the Algerian Greyhound. They are of a light-fawn color, and highly praised in their native country.

The smallest species of the Hound is the Beagle. They have large heads, long ears, angular bodies, with short and very crooked legs.

There were 11 exhibits of the Shepherd species. Those of France were quite large animals, with short hair and mostly of a black-and-tan color. Shepherd dogs.

The Scotch Collie, very highly valued in their own country, is of small size, with long and fine hair, usually black and white, with tan color on the ears, jaws, and legs. This species of the Shepherd-dog is very quiet in his actions and easily trained. Those on exhibition were mostly sold at high prices.

There was a large number of the Poodle species, mostly owned by the French, ranging from a medium-sized animal down to a pound in weight. Poodles.

Altogether, the Exhibition was a fine opportunity for the study of this species of animals.

Horses.

HORSES.

The exhibition of horses was the last of the series, and was held from the 1st to the 10th of September. In the mean time the stalls occupied by the cattle were rearranged to suit the purpose, and all the other pens removed from the ground. There were over 1,000 specimens of the race, comprising representatives of nearly every type known at the present time. I shall only give a brief notice of the most noted breeds of the present time that were on exhibition.

1,000 entries.

The modification of the European horses by the introduction of the Arab and Barb.

Of the form and nature of the early European horse but very little is known. The modern speed-horse of that country seems to have been entirely produced by the introduction of the Arabian and Barb from the East. Under the name of Arabian horses there are in Europe several varieties, but, either from the influence of climate or breeding and raising, they differ very much from the Asiatic horse. The most valued of the Arabian horses are those brought from Persia and Syria, but they are to be found in all Mussulman countries of Asia, Africa, and Europe.

The Arabian.

The Arabian, so widely known, and of which so much has been written, has, as it will appear, been extensively used in the improvement of the lighter horses of Europe. These horses are rather small size, seldom exceeding fourteen hands in height, and may be thus described: Head short, very wide across the forehead; dished face; muzzle fine; under jaw-bones large and wide apart; the eye full and mild, with a rather sleepy expression when quiet, but sparkling under the least excitement; the ear is small, pointed, and sensitive; the neck only moderately arched on top, and very light at the throat latch; windpipe very large and prominent; shoulders slanting and muscular; withers thin, and on some of the animals exhibited a little low, others full; ribs round; the back is straight; the hips narrow and rounded on top; the croup is straight and thin to a fault; the tail set on too high for our idea of symmetry; the limbs are finely formed, the lower parts flat and sinewey, with almost a total absence of flesh; pastern joint small, short, and straight; foot small, and hoof black and irony. They are of varied colors, and were represented by gray, bay, and black. They were all light in mane and tail small, with fine hair. The Barb horse is only the Arabian species with another name. They have the same form in nearly every particular, but it is thought the average size is less than the Asiatic race, and not so enduring on long journeys.

Characteristics.

The Barb.

English race-horse. *Horses.*

This horse, which is probably not a distinct race of horses, but only the outgrowth of a cross between the horses of the East and the native horses of England, has had his genealogy so often written that it is not worth while to repeat it here. The English race-horse.

The blood of the thoroughbred predominates in the beautifully formed saddle-horse, so highly prized for hunting. The clumsy horse, used in former times to draw the heavy coaches, has been remodeled by crossing with the thoroughbred until the value for the purpose used is doubled, and the thoroughbreds have found their way into almost every country in Europe, where their introduction has likewise been productive in improvement. In a number of instances they have been the founders of what may be classed a distinct race for specific purposes. The American trotting horse, in the hands of our people, has won a world-wide reputation for speed, yet it is largely but a dismembered branch of the English thoroughbred. Modification of English breeds by the blood of the thoroughbred. The American trotter.

Danish horses. Danish horses.

There is a large, coarse, and rough race of draft-horses found generally in Schleswig-Holstein. It does not possess the merits of a good draft-horse, being a great consumer and a loose-jointed animal throughout, with large, flat feet. Not being attractive in appearance, and possessing no points to recommend them, they have never been in much demand, and consequently have not spread outside of where they were first noticed.

The most noted of the Danish horses is known as the Jutland race. It is a breed of long standing, without any reliable history. All that is known of its early history is traditional. No stud-book or record of any form has been kept, yet it is said that great care has been taken to breed them pure. The Jutland race.

The Jutland horses are noted for their fine symmetry of form, and their adaptability for draft, speed, and saddle purposes. They are models of perfection of what we style "horses of all-work" in our fair catalogues. They are usually of a dark-bay color, with black mane and tail, and average in weight about 1,000 lbs. Excellent qualities.

They have sufficient size and strength for ordinary draft purposes, have the style and speed for carriage use, and are highly prized as cavalry horses. As a horse for agricultural purposes, it would be very valuable in our country, and, Size and style.

Horses.

The Jutland breed.

being a breed of long standing, would closely transmit its valuable qualities in crossing. Its value is recognized at home, and these horses command the highest prices of any class in Denmark.

Russian horses.

Russian horses.

Large infusion of Asiatic blood.

Throughout the vast empire of Russia the horsess have, without doubt, originally come from Asiatic sources, but have been much reduced in condition by hard usage and exposure to the severity of the climate. During the last century there were numerous studs established by the rich land-owners, where they bred horses with the intent of improvement, with varied results, by importing breeders from England and other countries. However, it does not seem that any but one particular type of a race was thus founded. That which has become one of the historical races of the country is known as the Orloff trotters, taking the name of their founder, Count Orloff Tchesmensky. It was in 1778 that the count established the stud, which soon became celebrated on account of the animals produced. By the history of this stud it is shown that very close inbreeding was followed for successive generations, and that the type of the race became very uniform.

The Orloff stud, established in 1778.

The Orloff trotters exhibited by the Grand Duke Nicholas.

The animals of this breed owned and exhibited at Paris by the Grand Duke Nicholas of Russia had a form somewhat resembling the English thoroughbreds, but much more that of the American trotter. They are heavier than the English, more symmetrical in form, and have a longer and more drooping rump. The limbs are shorter, heavier, and the joints larger, but indicative of great power and durability.

Characteristics.

The Grand Duke's stud.

The Grand Duke Nicholas of Russia has a remarkable fondness for the horse, and he is to-day one of the largest breeders in Europe. From early youth he had a great desire to establish a stud on a grand scale, with the hope of improving the horses of his country. He seems to have followed in the footsteps of other leading breeders by selecting the oriental blood as a basis to build from, but he had a different object in view. His desire was to combine speed, durability, and size, not exclusively for sporting purposes, but to produce animals that would generally improve the horses of his country, especially for the cavalry of the army. Both the oriental horse and the English racer were objectionable in size for the purpose. By present from the Emperor, in 1858, he became the owner of the grounds and buildings of the stud, then owned by the government, of

Design and scope of his system of breeding.

Tchesmensky, the original home of the Orloff trotters. Since that time his progress has been rapid, and now the stud contains probably the finest assortment of horses to be found anywhere, consisting of pure-blood Arabians; English and Arabian crosses, in which the oriental blood predominates; saddle-horses of superior form, with good size, the produce of a system of crossing; and the Orloff trotters as bred by their founder.

Horses. Russian horses.

The Orloff stud; exhibited by the Grand Duke Nicholas.

The enterprising breeder had twenty-seven animals at this Exhibition, which as a lot was one of the most attractive in the whole show. Each of the different varieties that he is breeding was represented by beautiful creatures. One of the most attractive animals in his exhibition was a dark-brown Barb stallion, imported from Barbary in 1867. This noble-looking animal was over 16 hands high, finely proportioned in every part, with the style of a war-horse, which in fact he is, being the steed that carried his master over the Balkan Mountains in the recent Russian and Turkish war.

The Barbary war-horse.

Hungarian horses.

Hungarian horses.

No country in Europe, in proportion to its territorial area, raises so many horses as Hungary. Other varieties of stock are much neglected, while the horse seems a specialty with the inhabitants.

Great importance of the horse interest.

The large number of horses used in the Austrian army nearly all come from Hungary, and in addition to this they export from 30,000 to 40,000 each year to other parts of Europe. For cavalry purposes the Hungarian horse ranks highest of any in Europe. The horse interests are aided by the government, which has established four studs, each supplied with 1,000 stallions, that are distributed through the country during the breeding season, and the raisers have the use of them at a small cost. No inferior male animal is allowed to reproduce. By this care the great majority of horses raised are superior animals, and the raisers realize good prices. For a succession of years the average price of horses exported was from $125 to $140. There were 56 horses exhibited from Hungary, under the direction of the government, from different departments, so as to more generally represent the horses of the whole country, with the intention of thus increasing by advertising their already large export in this class of stock.

Cavalry horses.

Yearly export over 30,000.

The governmental studs.

Average value of exported horses.

At the commencement of the present century horses of Hungary had no special claims to merit, but under the guidance of the Minister of Agriculture the blood of the Arabian and English thoroughbred has been at different

Systematic improvement since the commencement of the century.

Horses.

periods introduced, and now so generally infused throughout the country that the horses have assumed a very fair average type, which is, however, rather below the standard size of a good saddle-horse.

Hungarian.

But few heavy draft-horses.

The breeding of heavy horses for draft use has never had much attention in Hungary. Much of the labor in agriculture is done by cattle. In some parts of the country the horses are very large, and of late years are attracting attention for heavy work.

Flemish draft-horse.

Flemish draft-horses.

The heavy draft-horse was first found in Northwestern Europe, records showing that a race of large black horses existed there at an early period of history. They were well known to the Romans, who procured the most powerful horses for their cavalry from Belgic Gaul. On the coasts of the North Sea the descendants of these horses are yet found, but evidently much changed from the former type, if ever they were serviceable for cavalry purposes.

Belgic cavalry horses of the Roman army.

We find them mostly in Belgium, where they are classed by different names from the districts where raised, but they are really the same horse.

Horses of Hainaut and Brabant.

The Hainaut and Brabant horses are materially the same in form, but those found in Belgian Flanders are the real giants of the race. They attain the highest size and the greatest dimensions, usually about 17 hands high.

They are slow in gait and effeminate in temperament. This race at present seems to be but little removed from the type attributed to the primitive race of Friesland. The other classes of this race seemed to be much improved, but the lot on exhibition, which was numerous, did not show equal improvement with other races of draft-horses which history traces to the same origin. That a horse can be large and yet have the style and finish of an attractive animal was well shown by the other breeds in stalls by their side.

Characteristics.

Lincolnshire cart-horse.

Lincolnshire cart-horse.

The modern history of England finds the same large race of black horses there that was on the Continent, from whence they were doubtless derived. Their forms as described then are much the same as the Flemish horse now.

Origin.

The first regular attempt to improve them was made during the last century by the Earl of Huntingdon, who imported several Dutch coach-stallions, but of the results of this cross nothing is said. Many years afterwards Robert

Bakewell imported several mares from Holland and crossed them with the native stallions, and by pursuing a careful system of selecting and crossing made much improvement in the form of the original horse. Since that time there has been continued improvement, until now the great English draft-horse is classed as a breed. At the present time they are crossing with the Scotch Clydesdale, and the animals exhibited seem to bear proof of this in the fact that the black color, which distinguished the English draft-horse in the fore part of this century, has been bred out, and now bright bay and brown bay are the colors of those exhibited. There are also numerous teams of dapple gray to be seen of this breed.

Lincolnshire cart-horse.

Crossing with the Clydesdales.

These horses have the appearance of being herculean in strength, and they are not without that symmetry of form which makes them attractive to the eye. Two of these powerful horses attracted much attention. Carlton Tom, bred by Mr. Rigby, of Carlton Grange, England, a dark bay, three years old, was 17 hands high and weighed 2,200 lbs. He was a representative type of the others exhibited.

Strong but not symmetrical.

Great size attained.

These horses have great strength, but are unusually slow in gait. They are in demand, and bring good prices for the heavy drays in the cities. Of this breed comes what are termed the brewers' horses in London, which are said to be the largest horses in the world.

Gait and uses.

Suffolk Punch.

Suffolk Punch.

The Suffolk Punch is the draft-horse of the midland counties of England. Their origin is unknown, but some writers claim them to be descendants of the ancient Norman race. It is evident that they have been bred in a different line, with a view of combining more strength and action. In size they are less than the cart-horse just described, and have more muscle. The limbs are shorter and finer, without the long hair. For general use or work they are preferable to the great dray-horse, and are called the agricultural horse of the country. They show a more defined type of breed than the other, being nearly all a chestnut-sorrel in color, with silver mane and tail. They have an excellent reputation of being true pullers.

Descent.

Characteristics.

Color.

Reputation.

The animals of this race on exhibition were more in accordance with our ideas of the kind of draft-horses needed in our country than all others. In weight they were from 1,500 to 1,700 lbs., and undoubtedly have more action and durability than the others. Their feet are of medium size, hoof solid and arched in the bottom. In walking they have

Admirable type of draft-horse.

Importation recommended.

Horses. Suffolk Punch.

a long and quick step—a swinging trot, that saves the muscles of the shoulders.

The Suffolk Punch derives his name from the county of Suffolk, where history first finds him, and his surname from his square, compact form of body. The breeders of this race are proposing to call them "agricultural horses," but undoubtedly their original name will follow them.

Cleveland Bay.

Cleveland Bay.

This is a name given to a class of horses first noticed in Yorkshire, England, the name being taken from the district of Cleveland. The prevailing color is a bright bay. In the latter part of the last century the district became known for producing a heavy horse suitable for coach and cavalry purposes. They are the produce of a cross between the race-horse and the large native horses of the country, and are so well defined in type as to justify the classing of them as a breed. But their history shows that the breed has been subject to changes in form to suit the times. Traveling by steam has done away with the old-fashioned coach, and the improvement of public roads has reduced in size the cumbersome carriage used in those days; consequently, these horses have been reduced in bulk by a further infusion of the blood of the thoroughbred horse to conform to the wants of the times.

The typical carriage horse.

Reduction of bulk and increase of speed.

Those on exhibition were very symmetrical in form, the limbs lengthy and fine. They were classed in the catalogue as horses for the saddle—no doubt the most fitting place—and their value for cavalry purposes is beyond question. The demand for them at home and on the Continent for that purpose makes the breeding of them profitable.

Valuable saddle and cavalry horse.

Clydesdales.

Clydesdale horse.

This race of heavy draft-horses takes its name from the river Clyde in Scotland. The Clydesdales have doubtless a similar origin to that of the English cart-horse, and even now there is a resemblance between the two breeds. The Scotch have a tradition that during the twelfth century one hundred choice stallions were imported from Flanders, the same source from which the progenitors of the Lincolnshire cart-horse were derived.

Origin.

Comparison of purposes of the breeders of Scotch and English horses.

It is evident there has been a different object pursued in the breeding of the Scotch horse. The English breeders of the dray-horse seem to have had in view the aim of producing immense size and strength, combined with slow action. The Scotch, on the other hand, have as their object size,

Horses.
Clydesdales.

strength, and quick movement, which they have succeeded in establishing in the breed. This result has given them a superiority that renders them more desirable for many purposes, and therefore more valuable than the English cart-horse. At the present time the English breeders find the Scotch horse in better demand than their slower animal, being but a trifle less in size or strength. Their greater speed was well displayed, as they were moved at rapid gait while being examined by the jury. They have a reputation, like the Suffolk Punch, of being very true and steady pullers. Their general color is bright bay, though gray and brown are often seen among them. Their peculiar marks are a white stripe in the face and white hind feet, often extending up nearly to the hock.

Their superiority to the Lincolnshire.

Character and color.

Lawrence Drew.

The Clydesdales exhibited by Lawrence Drew, near Hamilton, Scotland, were very fine specimens of the race and showed much uniformity of type. As a group they attracted much attention, and were awarded the highest premium given to foreign draft-horses. That they command high prices at home is evident.

Prices realized.

At a public sale of Lawrence Drew, held at his home on the 9th of last April, we noticed that two-year old stallions brought, respectively, $975, $1,050, $1,500, and $2,400. The last-priced animal had a grand action and fine style, which at once stamped him as a Clydesdale of the very highest order. Action and style indicate the distinctive difference between the Clydesdale and the Lincolnshire.

French horses.

French horses.

Few exhibited of any defined breed.

The condition of the horse in France at the present time is very much the same as it is in the United States; but a small percentage of their or our animals are of any well-defined strain or stock. Of the 776 specimens in the stalls at the Esplanades des Invalides, it was surprising how few were classed as belonging to any particular breed.

Normans.

Normans.

Normandy is the great horse-raising portion of France.

Origin.

The original stock is supposed to be of the Germanic race, introduced by the Northmen invaders, which has been modified by importations from England. Many of the Normandy horses on exhibition were classed as "Anglo-Norman."

Prof. André Sanson.

Prof. André Sanson, a writer on this subject, refers to the mongrel character of the Norman horses as a body, and complains that ill-matching and ignorant crossing have sub-

Horses. Norman breed.

stituted a race of half-bloods in the place of the old race, admitting at the same time that no faithful description of the old race is extant. He refers to the fact that the "operation of crossing, always difficult to execute, especially in the horse, does not often produce the fusion of character sought to be realized. Thus, sometimes will be seen in the same horse the fore quarters of the ancient Norman and the hind quarters of the English, and *vice versa*." He adds that "out of every hundred born not more than 25 per cent. become good horses."

Prof. Sanson on the Norman horse.

This writer may represent the condition of these horses in their native districts, but it would not apply to the horses on exhibition. Here they denoted varied origin, but they must have been selected from the 25 per cent. of good ones, for they were generally of medium size, weighing from 1,000 to 1,200 lbs., with fine style and action. They would be classed with us, as they were at home, "horses for general purposes," many of which make fine carriage-horses, others for light-draft use.

Good style and action of the horses exhibited.

From among them come the horses used in the cabs of Paris, and a large portion of the cavalry horses. If the English thoroughbred and Arabian crosses have injured the form, it certainly has given them physical endurance, for the cab-horses of Paris are driven at a rapid gait for long trips over the solid streets, and, as a lot, they look better than that class of horses in other cities.

Uses for cab and cavalry purposes.

From the southern part of Normandy come the Percheron horses, taking their name from le Perche, a part of the old province of Maine, now included in the departments of *Orne*, *Eure-et-Loir*, and *Eure*. What is now called the Percheron Norman draft horse in our country is an assumed name on our part for horses imported from different parts of Normandy. Much has been written about them in our agricultural journals, mostly by interested parties, to prove their purity of blood and ancient origin. Some contend that they are strongly Arabian in blood, but the only resemblance that can possibly favor that supposition is the predominance of gray color in the two races. Others go back and claim them as descendants of the ancient Norman war-horse, but the fact is, they are, like the different races of cattle found in France, without known origin, and the genealogy of an American Indian is as well ascertained as theirs. There is not now in France any race of draft-horses classed under the name of Norman. The true Percheron horse, as I saw him in the streets of Paris and on exhibition, is about 16 hands high, weighing from 1,300 to 1,500 lbs. (mostly the former weight),

Percheron.

A name given by American importers.

Discussion as to their origin.

No well-defined Norman or Percheron race of horses.

with a short head, broad face, and a submissive eye, denoting more patience than ambition. The nostrils and lips are thick and unanimated, which are in unison with the expression of the eye. The neck is thick and short, withers extending well back on a sloping shoulder; back low, but very short between the withers and loins, which are wide and elevated above the line of the backbone. The rump is short and rounded. The limbs are well proportioned for a good rate of speed combined with strength, but are nearly free of long hair on the after part of the lower limbs; this latter is, however, the result of careful clipping.

Horses. Normans.

Characteristics of the Percheron.

It is estimated that there are 10,000 of these horses used in the city of Paris on omnibuses, street-cars, etc., and their fine appearance during hard service bears undeniable proof of their value.

Used in Paris.

Boulonnais draft-horse.

Boulonnais.

This large and valuable race of draft-horses made its first historical mark in the vicinity of Boulogne.

The Boulonnais horse has a large body, thick neck, and powerful limbs. There is no uniformity in the color. His constitution is excellent, and this breed furnishes the larger proportion of the horses used in Paris for heavy hauling.

Heavy draft-horse.

Breton horse.

Breton

The old Brittany race, which has such a long history, has become so mixed by crossing with the English horses that the former race is almost lost, and that country now has a reputation for producing good saddle-horses only.

Limousin horse.

Limousin.

In that part of France formerly the old province of Limousin there is a race under that name, which was formerly much noted for its oriental style and endurance, and history claims that when Charles Martel defeated the Saracens on the plains of Vouillé, near Poitiers, they fled leaving a large number of their Arabian horses in the hands of the victors. What reliance can be placed on this tradition each person may determine for himself.

Traditional origin.

For the purpose of improving the horses of the Limousin, the French Government established the celebrated stud of Pampadour, and introduced the pure Arabian, Anglo-Arabian, and English race-horse blood, until the horses produced have much of the oriental type, but still retain most of the good qualities found in the native stock.

The establishment of the Pampadour stud in Limousin.

I have mentioned the leading strains of horses as exhib-

Horses.

ited, all of which, with the exception of the Arab, have but recent origin as breeds and are the results produced by selecting and crossing. Much has been done in the past to establish a certain line of breeding, to concentrate the blood of different types in the same species of animals, so as to produce a race that will transmit in reproduction a new form. This is a difficult task to accomplish, and the proximate success is the result of years of selecting, attended with many disappointments and failures. It is evident that all the noted speed and valuable driving horses owe much to the infusion of the blood of the Asiatic horse, while we owe to the large horse of Flanders, or its vicinity, the modification of the various native races which now appear as breeds of draft-horses. The breeding to successfully establish a distinct color in the coat of any of our domestic animals is much more easily done than to produce a definite and established form.

General remarks on the run and effect of French horse breeding.

Result influenced by climate, soil, and keeping.

The influence of climate, soil, and the manner of keeping are all influences that affect the result. All improved breeds of domestic animals are variations from a normal condition, and have a constant tendency to revert to primitive conditions.

Our errors in overlooking the effect of environment.

One of the greatest errors that the agriculturists of our country labor under in their stock-growing results from misunderstanding or inattention to this fact, the reposing of all confidence in the race or breed and but little in the subsequent care. This neglect is sure to produce disappointment in the end, and too often the stock itself is charged with the failure instead of the breeder.

Reason of England's success.

Nowhere in Europe is the growing of live stock conducted on such fixed principles as in England, and no other country has met with so great success. The various agricultural districts have sought to produce the breeds of stock best suited to the character and quality of the land embraced in the given region, as, for instance, the growth of Leicester and Lincoln sheep in the flat and rich pasture counties, and the Southdown and Hampshire Downs on the short and sweet herbage of the chalky downs of the south of England. In all cases the native stock of the country has been used as a basis upon which to build up by selection, or importing from other districts such stock as was desired to produce the result in view.

Adaptation of breeds to habitat.

Improvements on the basis of the native stock.

The practice does not so generally prevail on the Continent. Thus, Holland had for centuries, probably, the same class of dairy cattle, and France has a number of distinct races, each of which has been bred to a remarkable uni-

formity in form, color, and essential qualities, as I have had occasion to remark in reference to the cattle of that country. How long many of these breeds have been in assuming their present uniform type we have no history to inform us, either as to time or methods pursued, but they are doubtless the result of care in selecting and mating for a specific object in view.

On the uniformity in form and color of French and Dutch breeds of cattle.

The equine species on the continent of Europe have until recently been very much mixed in breeding, but at the present time there is a general effort to centralize on distinct classes and breed to a standard. At the Exposition they were divided into three classes, viz, speed or horses of luxury, saddle-horses, and draft-horses.

Attempts to breed horses to a standard.

The amount of prizes offered was $30,000. Only experts were allowed to act as jurors, and their awards seemed to give more satisfaction than is usual in such tests of animal merit.

Prizes offered in the exhibit of horses.

There can be no doubt that the results of this Exhibition will have a material influence on the future breeding of horses in Europe, and it should have its influence in this country on the masses of stock-raisers by convincing them of the fallacy of breeding for chance results. It is true we have well-established breeders of all classes of stock, but how few of the many have fixed principles. But very few of those who attempt to make improvement by selecting and crossing succeed in arriving at anything that is permanent, on account of the want of patience and perseverance in the one direction. It is a difficult task under the most favorable circumstances. One, two, or three crosses are tried in a certain direction with partial success, when, instead of continuing on, some new project presents itself, and a new cross is attempted and all is lost.

Fallacy of breeding for chance results.

Systematic care and perseverance necessary.

The breeding of live stock is a science or profession that requires study and experience, and cannot be outlined in an essay. When our agriculturists and stock-raisers study the principles and act in concert, as is now being done in Europe, the stock interest in our country will appreciate in value and become a much greater source of revenue to our people.

Prospective improvement in the United States.

In concluding the report of my observations at the Exhibition I desire to say that I was everywhere kindly received by the officials and exhibitors, every opportunity being afforded me to gain the information that I desired.

Acknowledgments.

SAMUEL DYSART,
Additional Commissioner.

HORTICULTURE.

GEORGE W. CAMPBELL.

[Extract from the Official Classification.]

NINTH GROUP.—HORTICULTURE.

CLASS 85.—CONSERVATORIES AND HORTICULTURAL APPARATUS.

Gardeners', nurserymen's, and horticulturists' tools.

Apparatus for watering and keeping turf in order, etc.

Large conservatories and apparatus appertaining thereto. Room and window conservatories.

Aquariums for aquatic plants.

Fountains and other means for ornamenting gardens.

CLASS 86.—FLOWERS AND ORNAMENTAL PLANTS.

Species of plants and examples of culture exhibiting the characteristic types of the gardens and dwellings of each country.

CLASS 87.—VEGETABLES.

Species of plants and examples of culture exhibiting the characteristic types of the kitchen gardens of each country.

CLASS 88.—FRUIT AND FRUIT TREES.

Species of plants and specimens of products exhibiting the characteristic types of the orchards of each country.

CLASS 89.—SEEDS AND SAPLINGS OF FOREST TREES.

Species of plants and specimens of products illustrating the processes followed in each country for planting forests.

CLASS 90.—PLANTS FOR CONSERVATORIES.

Illustrations of the mode of culture adopted in various countries, with a view either to pleasure or to utility.

REPORT ON HORTICULTURE.

Assignment to duty.

Arriving in the city of Paris on the 30th of April, the day before the formal opening of the Universal Exposition of 1878, I was instructed by the Commisioner-General to take observations and report upon the subject of Horticulture as represented in the Exposition in Group IX.

Exhibits from the United States.

No exhibitions of plants, trees, or fruit were made by citizens of the United States in this group, and only two were offered. The first, specimen plants of a new variety of strawberry named "Forest Rose," by Leo Weltz, of Wilmington, Ohio, were injured by being wet with sea-water on the ocean voyage, and entirely lost by neglect after their arrival upon the Exposition grounds.

Strawberry plants.

Grape-vines.

The other was a choice collection of American grape-vines, sent by Bush & Son, and Meissner, of Bushberg, Mo. These vines were received in excellent condition, but were not allowed to be placed upon exhibition or planted within the Exposition grounds, from fear that they might be infested with the *Phylloxera vastatrix*, and they were destroyed, by peremptory orders from the French authorities, before my arrival. I was informed by Dr. McMurtrie that these vines were apparently healthy, and that the Commissioner-General had protested against their destruction, and requested that they should be examined by a French expert to ascertain their true condition. This was refused, and nothing short of the immediate destruction of the whole collection would be accepted, and they were accordingly burned. This action of the French officials seemed unjust and inconsistent, in view of the fact that American grape-vines and cuttings have been imported into their country by millions, within the past five years, and that vine-growers in some of their most important wine growing districts are largely planting these American vines as their only remedy against the *Phylloxera*, which is devastating their vineyards by killing their native varieties.

Destroyed by order from the French authorities for fear of the *Phylloxera*.

Great importation of American grape-vines and cuttings.

Great destruction of vineyards in Southern France by the *Phylloxera*.

I afterward learned that the *Phylloxera* had not yet been observed in the immediate vicinity of the city of Paris, although in the southern portion of France, bordering upon the Mediterranean and upon both sides of the river Rhône,

Report of Gaston Bazille on the destruction of French vineyards by the *Phylloxera*.

thousands of acres of vineyards have been destroyed. M. Gaston Bazille, of the Society of Agriculturists of France, in an address before the society, in the city of Paris, on the 14th of June, 1878, stated that 28 departments of France were more or less invaded by the *Phylloxera*, and that 288,000 hectares (711,648 acres) of vines were completely destroyed, as shown by official returns for the last year. Since that time the area had considerably increased, and the insect pursues his march with resistless and disheartening regularity. In the department of Hérault the advance is, every year, from 12 to 15 kilometers (7 to 10 miles) from east to west.

Rate of increase of the devastated area.

Experiments with American vines.

It is in this region that American vines are being planted, both for experimental vineyards and for stocks upon which to graft the French varieties of grapes, in the belief that the roots of many American varieties have the ability to resist successfully the attacks of the *Phylloxera*.

The condition of the grounds on the day of opening.

The day before the opening of the Exposition, the portion of the grounds between the Trocadéro Palace and the main Exposition building were in a very unfinished and incomplete condition on both sides of the river Seine. Large spaces of the ground were bare, and thousands of plants, trees, and shrubs were lying around unplanted, some in pots and tubs, and others with their roots in earth in wicker baskets or bound in matting. Others, including large trees 20 feet to 30 feet in height, were coming in on wagons and trucks.

There was a partial clearing up of the grounds for opening day, the 1st of May; but the ornamental planting and laying out of the space between the Trocadéro and the large Exposition building was not completed for some weeks afterward.

Rapid preparation and planting of lawns, walks, and grounds.

A month later, the planting was nearly complete, and handsome flower-beds, tastefully arranged groups of shrubbery, and smooth, green lawns occupied the space that had been so recently bare, rough, and unsightly. The rapidity with which the French gardeners transformed rough and barren spaces to smooth, green lawns was quite remarkable. The ground was carefully worked, producing a fine, even surface, then sown thickly with rye-grass (*Lolium perenne*), and covered with a light coating of rich, black compost. When rains were not suffiicent to keep the ground in proper condition, artificial sprinkling was used, and in eight or ten days the grass appeared, and very soon afterward the ground was densely covered and lawn-mowers were in requisition. These lawns of rye-grass were very beautiful; the turf thick, soft, and close, and the color a very bright

Rye-grass lawns.

and pleasing shade of green. For immediate effect it is very desirable, but, unfortunately, this variety of grass will not endure severe winter freezing, and for permanent lawns would not answer in northern localities in the United States.

Border beds of pansies and gilliflowers.

On each side of the main walk leading from the Trocadéro to the Exposition building were long beds or borders, edged with very finely grown pansies in great variety of color and variegation, and with blooms 2″ to 3″ in diameter; the centers of these borders were filled with gillyflowers, the outer edge next the pansies a ribbon line of white, the middle solid, in various shades of red and purplish crimson, quite pretty and effective.

Plants for immediate effect in borders and beds.

For early planting and immediate effect, for small borders, in angles and smaller spaces, daisies were also used, arranged tastefully in separate colors, in ribbon lines, with masses of deep color in the center. There were also large beds of cinerarias, in every variety of shade, color, and variegation, from pure white, through all gradations of blue, purple, and crimson, to violet-purple, so dark as to appear almost black, variegations white with black center, and many others. Very pretty effects were also produced by massing the mimulus in small beds, also the tropaeolums; some larger beds of *Tropaeolum minus* in great variety of color, the Tom Thumb or dwarf varieties at the edges and the tall-growing kinds gradually rising towards the center, producing an attractive and brilliant effect.

Magnificent display of rhododendrons.

The grandest display, however, was made at the opening and during the earlier days of the Exposition by the almost unlimited use of rhododendrons. Thousands of these magnificent shrubs were used with charming effect, both singly, in fine specimen plants, and also massed in long oval beds in various portions of the spacious grounds. Specially worthy of notice were the large borders on either side of the main entrance to the large Exposition building facing the Trocadéro towards the north, and extending the whole length of this end. These beds were eight in number, oval in form, rising gradually from the outside to the center, and planted with thousands of plants from 3′ to 6′ or 8′ high, all admirably grown, artistically arranged, and covered with myriads of exquisite blooms in every shade of color and variegation common to this regal flower. The effect was beautiful beyond the power of words adequately to describe. In another part of the grounds a large bed of pure white rhododendrons was also very beautiful, and attracted the attention from a great distance. This bed was also oval in form, about 100′ long and perhaps 30′ in width, a large plant

Splendid display of rhododendrons

some 6′ high, a mass of pure white bloom, forming the center. A thousand plants of the same variety, and all in perfect bloom, were massed in this bed, the lower ones at the outer edge, and all graduated towards the center plant, forming a dense and continuous sheet of pure white, intermingled only with the shining green of the foliage. These floral exhibitions were made by Vilmorin, Truffaut, Moser, Paillet, and others well known in America as well as in Europe. In a smaller way, and bordering the various walks in all directions, were very pretty and effective beds of brilliant-

Poppies, nasturtiums, alyssum.

colored poppies, also of nasturtiums and of *Asperula odorata*, veronicas, white and yellow alyssum, and of the *Primula*

Primula Japonica

Japonica in greater variety of color than I had before seen. There were whole beds of this latter-named flower in various shades, from white with delicate lemon eye, through varied gradations of rose, pink, and red, to darkest purple. Solid

Pansies.

beds of pansies, also, with flowers of enormous size, each bloom from 2″ to 3″ in diameter, were very interesting, from their infinite variety of color and variegation.

Parterres and plantations of evergreens, foliage plants, and geraniums.

Also, through the avenues of the main building and in every available nook and corner about the various supplementary buildings, fountains, and statues, little parterres and plantations of flowering and ornamental foliaged plants arrested and delighted the eye. Beautiful ornamental evergreens, azaleas, geraniums, and pelargoniums, in great variety of foliage and color, were used with fine effect.

In the portion of the ground bordering the river Seine, which had been recently filled up from 10′ to 20′, the grading and planting was very creditable to the skill of the French gardeners. Within the space of a few days, nicely graveled walks were made; beautiful flower-beds in bloom, edged with fresh, green sod; rows and masses of evergreens

Planting of large ornamental trees.

and ornamental shrubs. Large magnolia trees from 10′ to 20′ in height, horse-chestnuts and other trees from 20′ to 30′ high, were transplanted with a degree of success quite re-

Area of space planted.

markable. There were probably not less than 60 acres, outside of the great Exposition building, occupied by the various nurserymen and florists in the neighborhood of Paris in displays of specimen shrubs and trees, rare evergreens, flowering and ornamental foliaged plants, fruit trees trained in fanciful shapes, climbing plants, and also collections of the forest trees of various countries.

Flower-beds in variety of forms and color.

A very attractive feature in the ornamentation of the grounds was the planting of flower-beds, tastefully arranged in great variety of form and color, some of which may be worthy of record. Very pretty effects were produced in oval

and circular beds by edging with pyrethrum golden feather, followed by rows of begonias in different varieties, rising gradually towards the center, which was massed with low-growing ornamental shrubs of various kinds. Flower-beds on the Exposition grounds.

Small oval beds of zonal geraniums were also formed by massing a single variety of marked and distinct character, the beds being first cut out of the green lawn and slightly raised at the center. The following were among the most remarkable: Zonal geraniums.

No. 1. A sample bed of a new zonal geranium of 1878, "Joseph Dubois" (*Mézard*), was noticeable for dwarf, compact habit, well-formed, medium large flower, of intense vermilion-scarlet.

No. 2. "Flora Millin" (*Mézard*), large foliage, with broad black zone; large flower, with white petals and salmon-red throat, edged with same color. Novel and pretty, but does not appear to stand well under hot sun.

No. 3. A close ribbon-edge of silver-leaved geranium; center filled solid with geranium "Jouvier de la Motte," of medium dwarf habit; foliage crimped; zone broad and distinct; flower and truss large; color deep cherry-scarlet. Apparently a fine bedding sort.

No. 4. Edge, double geranium "Madam Thibaut," rosy purple; center, "Pelleport," single zonal geranium, in solid mass, a brilliant orange-scarlet, with large flower and truss and long flower-stems. Rather straggling in habit, not compact enough for a good budding variety, but very brilliant in color.

No. 5. A long, oval bed, edge with *Centaurea candidissima*, the center planted close with red-flowering, tuberous-rooted begonias, among which, at regular intervals, were planted tree-formed, various-colored geraniums, both double and single, 3′ to 4′ high, with single stems and spreading, bushy heads. Centaureas, begonias, and geraniums.

No. 6. A very effective bed of large-flowering, dwarf coxcombs (*Celosia*) of various colors, from light yellow, through all gradations of orange, crimson, rose, and scarlet, attracted much attention for its large, well-formed bloom and brilliant colors. Coxcombs.

No. 7. An interesting bed of tuberous-rooted begonias, with large and brilliant flowers, including "Vesuvius," "Prince of Wales," "M. Blenaime," very large, bright red; "Prince Leopold," remarkable for abundant bloom; a new double variety, *Salmonea plena*, light red, flower quite regular, four large petals equidistant and uniform, with handsome rosette in center. Begonias.

Flower-beds on the Exposition grounds.

No. 8. Oval bed, edged with silver-leaved geranium; second row, wide band of "Madam Thibaut," double geranium

Geraniums.

of dwarf habit and free-blooming, light, rosy purple; center massed with geranium *Guillem Mangilli*, semi-double, very dark cherry-scarlet, and free-bloomer.

Annuals.

Some very fine displays of annual flowers from seed, in great variety, tastefully arranged under handsome tents or awnings, were made by Vilmorin, Andrieux, & Co., and A. Lecaron.

Change of flowering plants as the season progressed.

The long, oval beds on each side of the walk from the Trocadéro to the Bridge of Jena, that were filled with stocks or gillyflowers at the opening of the Exposition, were changed by removing the first plants as soon as they declined in bloom, and replacing them with solid masses of *Coleus Vershaffeltii*, edged with a band of *Gnaphalium lanatum*, its silvery white foliage contrasting finely with the dark crimson-maroon of the coleus, and remaining permanently effective and handsome to the close of the Exposition.

Flower-beds in lawns or bordered with turf.

These ornamental oval flower-beds, standing in prominent relief upon green lawns, or where planted in parks surrounded by gravel walks, edged with a broad band of green turf, are very characteristic in French gardening, and are found not only in the Exposition grounds, but in the public and private gardens and parks throughout the city of Paris. Some were quite simple, depending for effect upon the beauty of single varieties, made impressive by being massed in large quantity; others using plants in great variety, dissimilar in color and form, in sharp contrast. A bed in Park Monceau was very striking and unlike any other I had seen. A gently raised oval, cut from bright-green turf, was closely edged with blue lobelia; the center filled with "Mrs. Pollock" golden tricolored geraniums, regularly alternated with *Achyranthus Lindenii* and lobelia, compactly massed together.

Borders of flowering plants along the walks and around the detached buildings.

Throughout all the avenues of the Exposition building and bordering the walks in the grounds about the Trocadéro and the many supplementary buildings, bazaars, cafés, greenhouses, and national structures, there were long borders and ribbon-lines of flowers in great variety of design, generally tastefully arranged, and kept in perfect order during the whole period of the Exposition. Some beds planted thickly with variegated petunias were quite pretty. Borders also along the sides of buildings were formed with an outside line of grass next the walk; then a row of variegated alyssum, followed by two lines of pyrethrum golden feather; then a wide band of *Perilla Nankinensis*, finishing with a closely planted row of cannas next the wall. Another

of similar character was formed by an outside line of turf as before, followed by lines of lobelia, *Centaurea candidissima*, scarlet geraniums, single white pyrethrum, with a background of cannas, rising next the wall or building. Flower-beds on the Exposition grounds.

Other beds were of oval form, edged with grass; an outside row of zonal geraniums, salmon center, with white edge, succeeded by a line of brilliant scarlet geraniums; the center filled with a miscellaneous collection of flowering plants, such as begonias and fuchsias, petunias, calceolarias, coleus, and various others.

Around the base of the colossal head of copper, intended for an electric light or beacon for New York Harbor was a very pretty border; front line *Mesembryanthemum crystallinum*, or ice-plant, followed by a band of alternanthera; then a line of *Centaurea gymnocarpa;* a row of dwarf fuchsias, followed by a row of taller growth of the same, finishing with a closely planted row of oleanders, in red and white, alternate. All these borders were planted with dwarf or low-growing plants next the walk, each alternate row rising higher in regular gradation, the tallest plants being either next the walls or sides of buildings or at the center of the beds, according to the different construction or purpose for which they were intended. The border plants around the colossal head of "Liberty", designed for New York Harbor.

A large oval bed, about 4′ wide and 20′ long, planted solid with the golden tricolored geraniums "Mrs. Pollock," was very pretty and effective, both near by and at a distance, retaining the beautiful variegation of its foliage and showing an abundance of brilliant scarlet bloom.

A very pretty ornamental bed in the grounds near the Ornamental flower-beds.

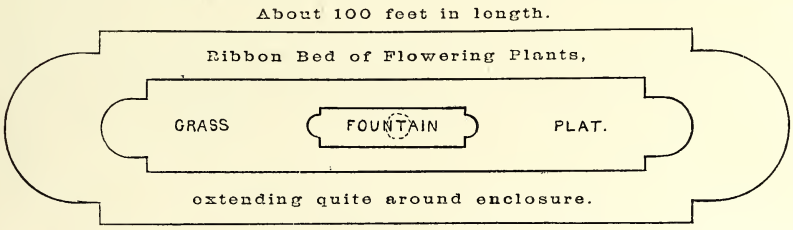


FIG. 1.—*Ornamental flower-bed.*

"Salon," or Palace of Industry, surrounded by tall trees—elms, planes, and horse-chestnuts—not too ornate, will illustrate the character of French gardening in this direction. In the center of the space represented by Fig. 1 stands a small fountain. The whole inclosure is surrounded by a low, neat iron railing, inside of which is a narrow, clean gravel walk, bordered by a belt of ivy, compactly grown, about 1′ wide; then a row of white-flowering, tuberous-

Flower-beds in the Exposition grounds.

rooted begonias, followed by a row of light rose-colored nosegay geraniums. Next, a row of brilliant scarlet zonal geraniums, succeeded by white artemisia, which completed one side of the band, gradually rising to the center line, which was composed of tall-growing fuchsias and cannas in alternate succession. From this center line of fuchsias and cannas the same order of succession was observed on the inside—white artemisia, scarlet zonal geranium, rose-colored nosegay geranium, white-flowering begonias, finishing with ivy, and the path or walk of white gravel. The inside smooth, close, green turf, surrounding the fountain.

Geometric flower-beds.

There were also in the Exposition grounds several highly artificial flower-beds, in regular geometric figures cut out of the grass, and filled with lines of various colored flowers or variegated foliaged plants, and which were curious, rather than tasteful or beautiful. A sketch of one of these performances (Fig. 2), which surrounded a statue in the

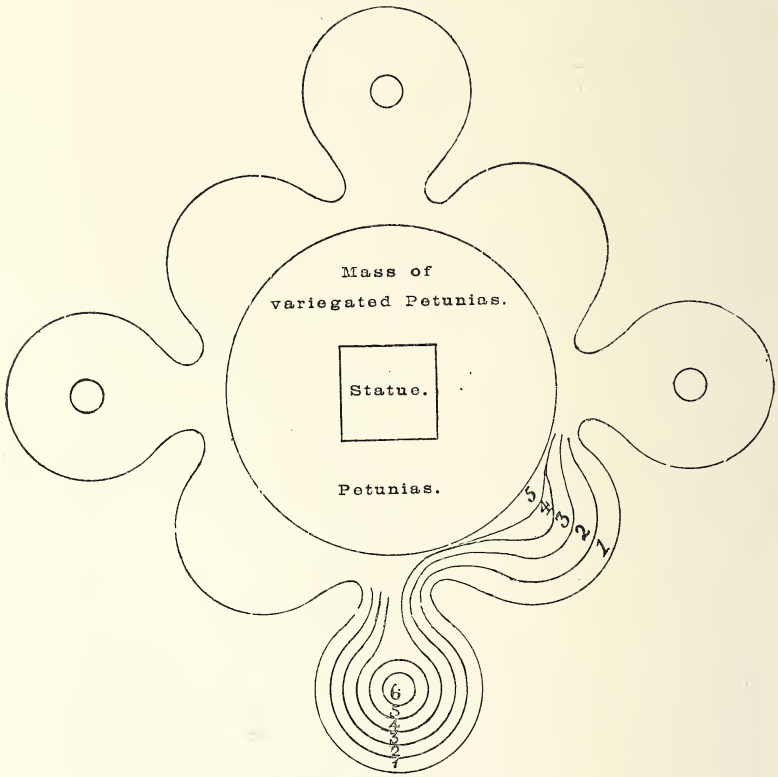


FIG. 2.—*Geometric flower-bed.*

grounds, will give a better idea of their general character than could be conveyed by simple description. Although

much skill and labor was expended in forming and planting these geometric beds, the effect, when finished, was unnatural and far less pleasing than the more simple and unambitious flower-beds and masses of shrubbery which surrounded them, and some of which have been heretofore described.

Flower-beds in the Exposition grounds.

1st. Outside row of echeverias, carried around the whole circumference of the bed. 2d. Pyrethrum prince's feather, yellow, feathery foliage. 3d. Alternanthera, variegated foliage, red, purple, orange, and green. 4th. Another row of pyrethrum prince's feather. 5th. Filling up to center circle, blue-flowering lobelia. 6th. Center of small circles, an agave, bedded in green moss. The other plants carried around the whole figure in circular lines and in regular order. The center massed with closely planted variegated petunias.

Geometric flower-bed. Figure 2.

There were two or three more similar works in different parts of the grounds, some even more ornate and artificial in character, but which did not seem to me worthy of more special mention or description.

Some oval beds of brilliant-colored double zinnias of various shades were quite pretty, the dwarf Mexican variety being used for edging, the center filled with the taller-growing, larger sorts, in thickly-planted masses quite covering the ground.

Oval beds of zinnias.

A similar bed, edged with silver-leaved geraniums, followed by a band of double rose-colored, and the center filled with brilliant scarlet zonal geraniums, with a surrounding of bright-green, closely-shaven turf, was also showy and attractive.

Geraniums.

Another long, oval bed, cut from the lawn and planted entirely with one variety—the bicolor zonal geranium "Queen Victoria"—was both striking and effective; the green and yellow foliage, with dark-brown zone and abundant bright-red bloom, affording a fine and pleasing contrast.

Zonal geraniums.

A circular flower-bed about 30′ in diameter, both novel and pretty, was formed by covering the ground thickly with dwarf, low-growing plants of scarlet-flowering geraniums, from 6″ to 12″ high, the lower plants at the outer edges, rising evenly to the center of the bed, and forming a kind of undergrowth to the tall, tree-shaped geraniums which were planted at regular intervals of two or three feet throughout its whole extent. These tree geraniums, in double and single varieties, were trained to single stems, 3′ to 4′ high, with

Bed of dwarf geraniums, studded with tree geraniums.

Flower-beds in the Exposition grounds.

regular, bushy heads, and were in full bloom, in great variety of color, each plant a handsome specimen.

The two long, open avenues running the whole length of the main Exposition building, on each side of the section devoted to the exhibition of the fine arts, and which occupied the central portion of the great structure, were lined on each side with handsome borders of flowers, generally artistically and tastefully displayed. Along the "Street of

Alongside the main building in Champ de Mars,

Nations" these beds were formed by planting a narrow belt of short green turf in front, next the walk, followed by rows of echeverias, golden pyrethrum, or some distinct low-growing plant; then inside, and extending to the walls of the buildings, a mixed collection of flowering plants, gradually rising from the front, composed of brilliant-colored geraniums, double and single. At regular intervals the ornamental silver-leaved geraniums were introduced, and on each side of the various doors and side entrances along the avenues were tall-growing palms. At intervals of 6′ or 8′, and breaking the monotony of these long borders, were larger plants of *Hibiscus grandiflora*, musas, ricinus, cannas, and small palms, the intervening spaces closely filled with assorted geraniums, fuchsias, yellow calceolarias, white pyrethrums, heliotropes, and begonias in variety. Every

the "Street of Nations,"

available space along this "Street of Nations," and its corresponding and parallel avenue on the other side of the Fine Arts Section, and all the spaces in front of the various national buildings, were filled with handsome groups of plants and shrubbery and tasteful flower-beds in various styles of ornamental planting. Midway upon these center avenues, and occupying a central position in the great building, stood a handsome structure, built by the city,

and the "City of Paris" building.

and named the "City of Paris." At each end of this building were two long squares, separated by walks between, and leading to the main entrances. These squares were edged by low ornamental iron railings, succeeded by a belt a foot wide of close, short grass; then a row of variegated-leaved alyssum (*Koniga maritima variegata*) followed by a row of dwarf-growing brilliant scarlet geraniums; then a row of taller rose-colored geraniums; at the center a broad band of white pyrethrum, broken at regular intervals by taller cannas and fuchsias planted alternately. On the inside of this center bands rose-colored and scarlet geraniums and the *Koniga maritima* completing the line, which extended entirely around the squares. The central portion of these squares was occupied by large ornamental vases

containing handsome palms, which were surrounded by smooth and well-kept grass.

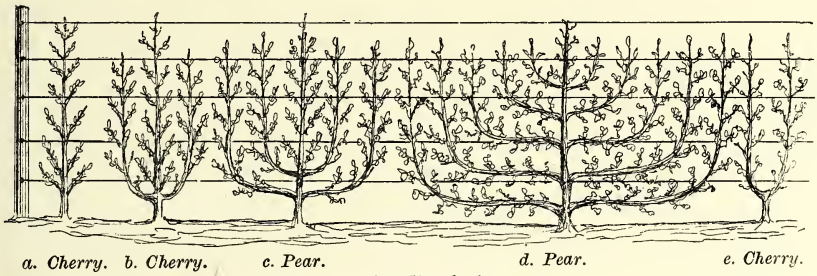
Rock-work, caves, and aquaria.

Great skill was also displayed in several portions of the Exposition in the building of artificial rock-work, forming grottoes, caves, aquaria, etc., of cement and a rough, porous, hard, and very durable stone found in the vicinity of Paris. Some very pretty effects were produced by planting trailing vines and shrubs, and forming cascades of water running over and among these rocky structures and falling into artificial basins containing aquatic plants. This artificial rock-work is evidently very durable, for in Park Monceau and other places about Paris are structures of this kind of many years' standing, apparently as perfect as when first made. This is probably because of the more equable climate and comparatively moderate winters, for works of this kind do not seem to have the same permanency in this country.

Cascades and basins of aquatic plants.

Espaliers.

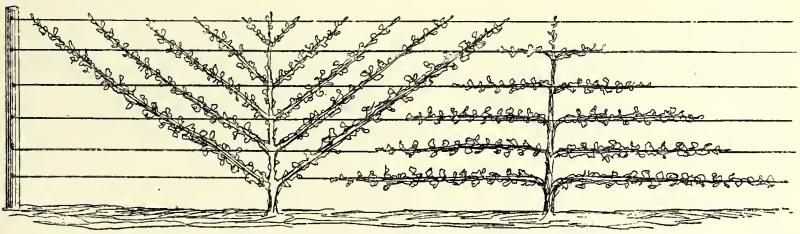
There were also large spaces outside the Exposition building on the eastern and western sides, as well as at the south



a. Cherry. b. Cherry. c. Pear. d. Pear. e. Cherry.

FIG. 3.—*Espalier fruit trees.*

end, occupied by horticultural productions, mostly contributed by large commercial nurseries from the vicinity of Paris.



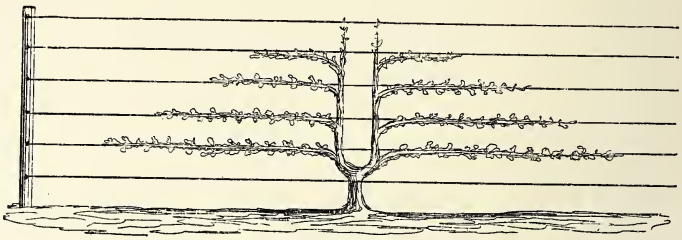
f. Peach. g. Apple.

FIG. 4.—*Espalier peach and apple trees.*

Several interesting collections of fruit trees, trained in some of the fanciful shapes for which the French gardeners

Espalier fruit-trees upon wire trellis.

have been long celebrated, attracted much attention. Several of the most characteristic forms are shown in the succeeding figures, which will give a more intelligent idea of this kind of work than an elaborate written description.



h. Pear.

FIG. 5.—*Espalier pear tree; horizontal training.*

Horizontal training.

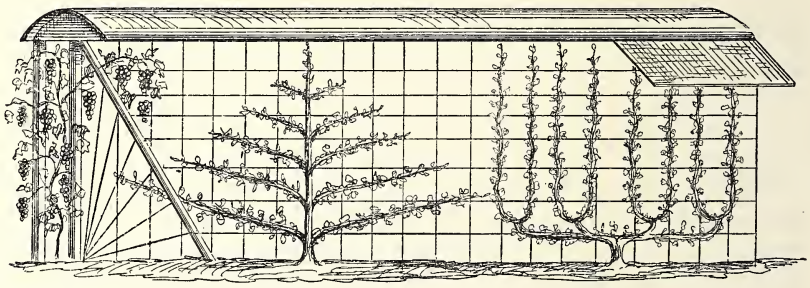
Of the trees in Figs. 3–14, examples *a*, *b*, and *e* were made from cherry trees, but there were also both pear and apple trees trained in the same forms; examples *c*, *d*, *h*, *l*, *n*, *p*, *q*, and *r* from pear trees; examples *g*, *k*, *o*, *s*, and *t*, apples; examples *f*, *m*, and *u*, peach trees.

Trellis.

These trees had been trained to their peculiar shapes in the nurseries, and were transplanted to the Exposition grounds in March and April. As represented in the drawings, they were mostly supported by light wire trellis, upon which the limbs were spread flat or fan-shaped, and in some cases additional supports of light wooden lath were tied with willow twigs both to the limbs and the wires, holding them in position.

Covered trellis.

Fig. 6 represents a covered trellis arranged also for wider covering where additional protection may be needed, as



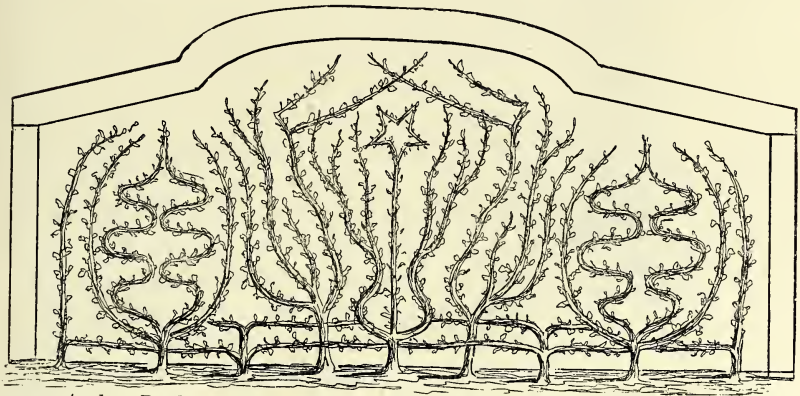
i. Grape. *k. Apple.* *l. Pear.*

FIG. 6.—*Covered trellis with wires for training espaliers.*

shown at the right. This trellis was formed of horizontal wires, as represented, crossed also at regular intervals by light, upright, wooden slats, to which the limbs of the trees were fastened.

Fig. 7 represents the most elaborate work of this kind in the Exposition. At each end an apple tree, with the lower limb trained in "cordon" in front; two other apple trees, trained in double "cordon" for a low line in front of the

Espalier fruit-trees.

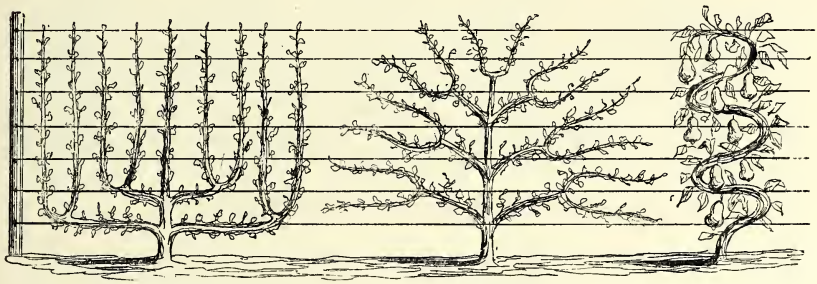


m. Apple. Peach. Apple. Peach. Peach. Peach. Apple. Peach. Apple.

FIG. 7.—*Ornamental wall-training. Peach with apple cordon in front.*

wall upon which the principal training was done, with five peach trees, which were made to form the figures as represented, and which figures were first sketched upon the wall behind.

Wall training.



n. Pear. *o. Apple.* *p. Pear.*

FIG. 8.—*Candelabrum-training, fan-training, and spiral training.*

Fig. 8 represents, in example *n*, a pear tree trained flat on trellis, differing somewhat from example *l*, both being modifications of what is called the "candelabrum," with branches in the V form. Example *p* represents a pear tree in spiral form, not on trellis. This spiral form is thought to increase productiveness, and is given by training to an iron rod of the desired shape, which is planted in the ground near the stem of a young tree, which is kept tied to the rod as its growth proceeds. Some specimens of this spiral training, both of apple and pear trees, were exhibited, planted in pots, showing great productiveness upon quite small trees in very limited

Candelabrum training.

Spiral training.

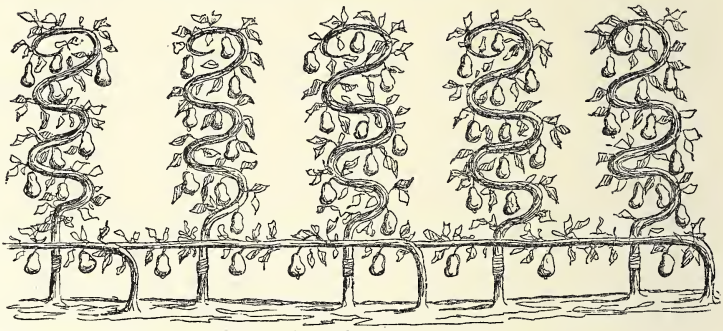
Spiral training of fruit-trees.

space. Fig. 9, example *q*, represents one of these trees trained in spiral form in pots, which seemed wonderfully productive; small trees, 18″ to 20″ across and 4′ high, bearing from 10 very large to 20 and 30 smaller pears to the tree. Another style of spiral training applied to both pear and apple trees, more frequently to the former, will be found in Fig. 10, *r*, where it is united with the "cordon." A row of pear trees is planted in line, bent downward, and trained upon a horizontal wire about 18″ from the ground. When the growth of a tree reaches the stem of the next in the row, it is united with it by grafting or inarching. At regular intervals along the line stakes are driven, to which are bound upright, spiral iron rods, and to these rods are trained limbs from the "cordon" line, forming a row of spiral branches growing upward upon the horizontal-trained trunks.

q. Pear.

FIG. 9.—*Spiral in pot.*

Cordon and spiral training.



r. Pears.

FIG. 10.—*Cordon and spiral training of pears.*

Cruciform training.

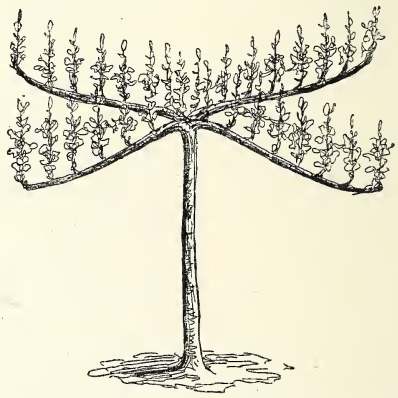


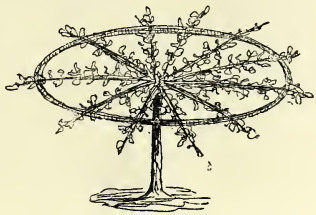
FIG. 11.—*s. Cruciform-trained standard apple tree.*

Fig. 11, *s*, represents an apple tree with four lateral branches, trained horizontally in regular X or cross, with

short, upright shoots at regular intervals. This form is given by the use of two iron rods (Fig. 12, *t*), which are bent upward at the ends, traversed by three iron wires, to which are bound light wooden slats, to give support to the upright shoots. Fig. 13, *u*, represents an apple tree trained in horizontal, circular form, the branches radiating from the center and tied to wooden laths fastened to an iron rod at the circumference, giving a flat, wheel-shaped head about five feet from the surface of the ground.

Cruciform training of fruit-trees.

FIG. 12.—*t. Training frame.*



Circular training.

FIG. 13.—*u. Circular-trained standard apple tree.*

Fig. 14 represents a favorite method of training peach trees, with a "cordon" of apple trees for a front line.

Fig. 15 represents an ornamental tree growing in a box in the Garden of Acclimation, and is introduced as a specimen of the skill of the French gardeners in grafting and manipulating the growth of trees, and as illustrating

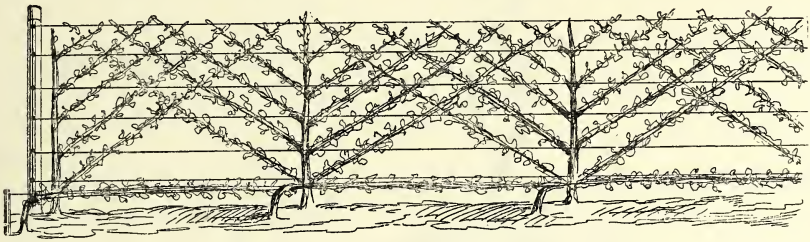


FIG. 14.—*Espalier peach trees, with cordon of apple trees.*

their characteristic fancies in this direction. Five small trees were first planted near each other in the box. At a foot high these five trees were made to unite and form one stem; this stem afterwards branched; then two stems on each branch twisted like a cable; then united above and forming a single stem, which was successively broken and formed into loops of different shapes, as represented, terminating in an even, umbrella-shaped head, about 15′ in height.

Fan-training with cordon.

This artificial training of fruit trees is not without its advantages, and is by no means merely a matter of taste or fancy. Such forms are selected as will cover and occupy most completely the wall or space assigned to them, and at the same time induce the greatest fruitfulness. All redun-

Advantages of these modes of training.

Artificial training of fruit-trees.

dant wood is pruned away, and the whole energies of the tree directed to the production of the greatest possible amount of fruit.

There are a great many other forms of training used by the French gardeners, some much more elaborate than those described. Some also are not adapted to walls or trellis, but to open spaces in orchards or gardens, and the cone, the *quenouille* or distaff shape, and the goblet form are most common; but all trained with great regularity, and forced to assume the desired shape by pruning and tying, and the use of wires, cords, and lath, during the earlier periods of growth. Very ingenious methods are often used to produce symmetry or to furnish branches upon particular portions of trees.

Tree with inarched stem.

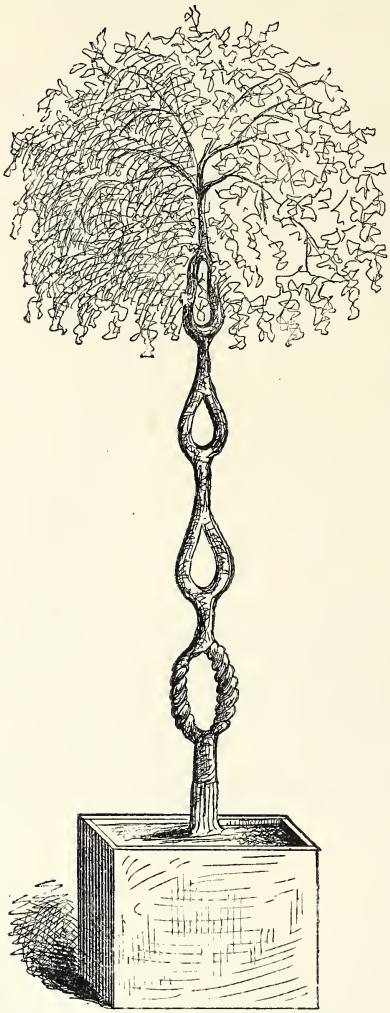


FIG. 15.—*Ornamental tree with inarched stem.*

Fig. 16 represents a limb bent over and inarched at the point of crossing. Supplementary limbs are often added by budding and grafting, and sometimes young trees are planted near by in convenient position, and the tops inarched to supply missing branches.

Trained pear-trees, Figs. 17–21.

Figs. 17 and 18 show some additional and characteristic forms of training pear trees employed in French gardens; Figs. 19, 20, and 21 are also some of the more elaborate styles of this kind of work.

This kind of work involves much care, combined with both taste and skill, and can only be profitable where labor is cheap and space limited and valuable; but there are many places in gardens and yards in towns and cities where unsightly walls, fences, and out-buildings might be utilized

Advantages in hiding unsightly objects.

Artificial training of fruit-trees.

by some of these methods or modifications of them, and covered by grape vines, peaches, pears, apples, or other fruits, and thus be rendered not only pleasant to the eye, but sources of pleasure and health to their owners and their families.

Inarching.

FIG. 16.—*Mode of inarching.*

Besides these specimens of fruit trees, there were handsome collections of roses in great variety, both of the standard form, grafted three or four feet high upon straight stems of manetti or other stocks, and also of dwarf varieties, growing upon their own roots. Also many large and interesting collections of evergreen and deciduous shrubs

Quadrilateral training.

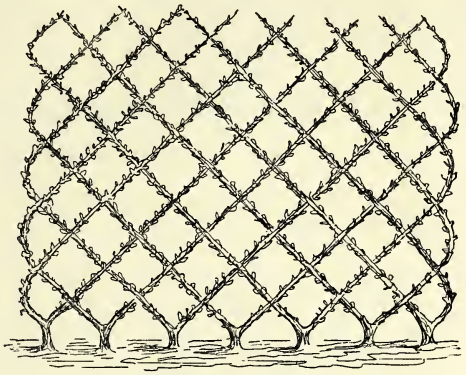


FIG. 17.—*Pear trees trained in V shape, crossed.*

and trees, climbing plants, together with the smaller fruits, strawberries, raspberries, etc.

Candelabrum training.

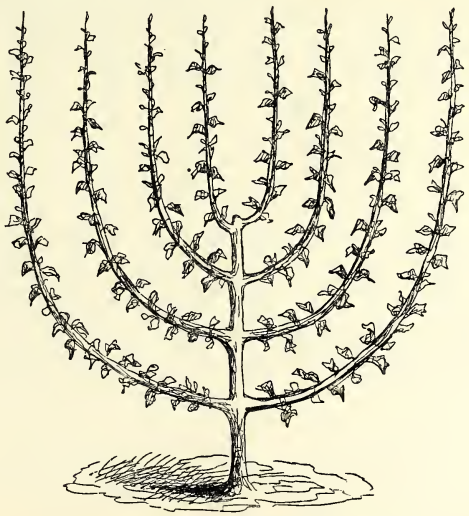


FIG. 18.—*Pear tree candelabrum shape.*

Artificial training of fruit-trees.

It would be impossible, even were it desirable, within the limits of this report, to give a complete list of the various

Spiral cordon training.

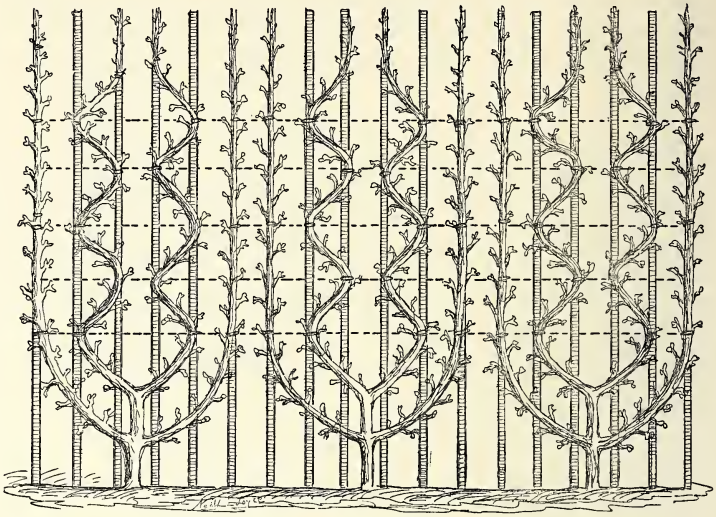


FIG. 19.—*Pear trees in spiral cordons, with two tiers of branches.*

exhibitions in this line, and only a few of those which seemed specially worthy can be noticed, even by name.

Palm training.

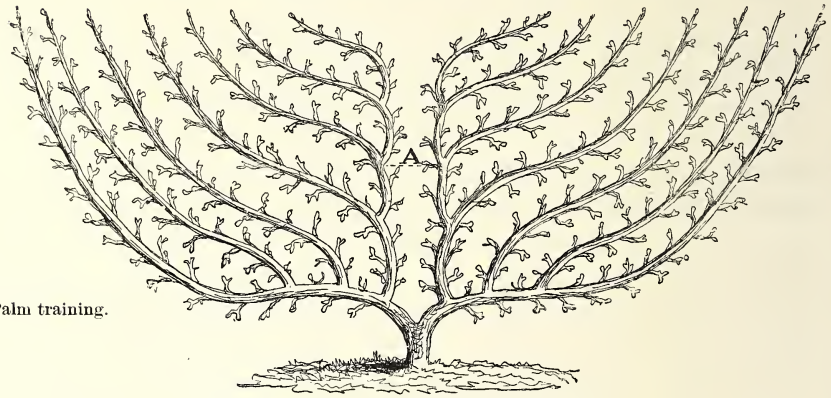


FIG. 20.—*Pear tree trained in palm shape.*

Very handsome and choice collections of rare evergreens from the nurseries of celebrated growers in the vicinity of Paris were tastefully grouped in different parts of the Exposition grounds. The following varieties of ilex or holly were among the most ornamental and distinct in character:

Ilex.

Aquifolium aureum maculatum.
Balearicum.
Aquifolium calamistratum aureum.
Aquifolium contortum.
contortum maculatum.
ciliatum and *cil. minus.*

Evergreens. Hollies.

Aquifolium dentatum aureum.
ferox.
ferox argenteum.
ferox aureum.
flammeum aureum.
hybridum latifolium.
lutescens, foliis variegatis.
latispinosum ovatum.
Aquifolium marginatum album.
marginatum aureum.
marginatum bicolor.
marginatum robustum.
pendulum marginatum.
serratum.
Wateriana.
furcatum.

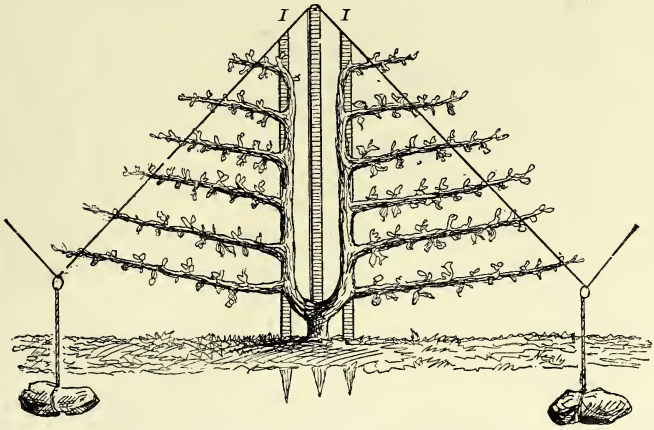


FIG. 21.—*Method of training on galvanized wire.*

Evergreen shrubs and trees.

Among the miscellaneous evergreen shrubs and trees the following were very beautiful and interesting; and although many of them cannot be grown successfully in open air in the Northern States, at the South they would doubtless succeed and be very useful in ornamental planting. The fine plantations of large magnolias have been before mentioned. Many of these, from 10′ to 15′ in height, were planted by Louis Leroy, of Angers, who had also a large and flourishing collection of *Camelia Japonica* planted in mass in the grounds. Also:

Ligustrum Sinensis, a very pretty evergreen shrub, with white bloom.
coriaceum, compact, dense green.
Taxus Canadensis aurea.
Hibernica, fol. variegata.
baccata elegantissima, golden-tipped foliage.
baccata Dovastonii, very handsome, with red berries.
Biota orientalis compacta and *compacta variegata.*
orientalis aurea.
Buxus elegantissima variegata, handsome tree-box.
sempervirens compacta, fol. aurea variegata.
Japonica aurea, variegation indistinct.
myrtifolia glauca, compact, dark green, pretty.
Retinospora plumosa aurea.
pisifera var. *aurea.*
lutescens.
obtusa.
plumosa flava.

Evergreen shrubs and trees.

Retinospora filiformis.
elegans.
Juniperis Sinensis alba.
Osmanthus ilicifolius (holly-leaved).
aquifolius.
latifolius variegatus, very pretty.
nanus variegatus.
Salisburia adiantifolia, fol. variegata.
Rhamnus alaternus, foliis argenteis.
Hedera helix arborea, dark-green, dense foliage.
arborea, foliis punctata, very handsome.
Euonymus, variegated foliage in variety.
Cephalotaxus grandis, large, fine specimens.
Sciadopytis verticillata.
Sequoia gigantea, very flourishing.
Torreya grandis.
myristica.
Podocarpus Pendiana.
elongata.
Daphne Cneorum major.
Dammara Brownii.
Abies bracteata,
Monte-Draco.
nobilis glauca.
Taxodium sempervirens, albo spica, branches tipped with white; very pretty.

As an indication of the extent of the exhibits made by the nurserymen of France, it may be mentioned that M. André Leroy, of Angers, had over 2,000 species and varieties of fruit and nut bearing trees and over 2,500 of ornamental and forest trees, including evergreens and flowering shrubs.

André Leroy.

The following were also among the important exhibitors in the same department, but I have no exact data of the extent of their exhibitions:

French exhibitors.

Nursery of the City of Paris, Auteuil.
Departmental School of Arboriculture, Saint-Maude.
Garden and greenhouses of the Luxembourg, Boulevard Saint-Michel.
M. Chantin, Avenue de Chatillon.
MM. Lévêque et Fils, Ivry (Seine).
MM. Vilmorin, Andrieux, et Cie, Quai de la Mégisserie, 4, Paris.
M. Jamin, Bourg-la-Reine (Seine).
Mme. Ve. Durand, Bourg-la-Reine (Seine).
M. Margottin, *père,* Bourg-la-Reine (Seine).
M. Margottin, *fils,* Bourg-la-Reine (Seine).
MM. Thibaut et Kétélêer, Sceaux (Seine).
MM. Crouse et Fils, Vallée d'Aulnay, near Sceaux.
M. Truffaut, Versailles.
M. Moser, Versailles.
National School of Horticulture, Versailles.
Nurseries of the Trianon, near Versailles.
M. Chevalier, *père,* Montreuil-sous-Bois (Seine).
M. Salomon, Thomery (Seine-et.Marne).

There were, altogether, 317 entries in the department of horticulture, 236 of which were from France and 81 from other countries. Entries in the class of horticulture.

From the United States, I find in the list of exposants only the following: United States exhibitors.

Biernatzki & Co., Philadelphia, lawn-mowers.
Brown, Hinman, & Co., Dayton, Ohio, horticultural tools.
Chadborn & Coldwell, Newburgh, lawn-mowers.
Department of Agriculture, Washington, models of fruit.
H. B. Douglas, Middletown, pumps in variety.
Lloyd, Supplee, & Walton, Philadelphia, lawn-mowers.
Markt & Co., New York, lawn-mowers.
Mast, Foos, & Co., Springfield, Ohio, lawn-mowers.
Oscillating Pump Company, New York, pumps.
Sheble & Fisher, Philadelphia, horticultural tools.

There were horticultural exhibitions of fruits, flowers, and vegetables, on the 1st and 15th of each month, in two long, narrow buildings erected for these purposes upon the Exposition grounds near the Seine, upon its left bank. I attended most of these exhibitions, and took notes of such things as appeared most valuable and worthy of notice. The exhibitors were mainly from the vicinity of Paris, and the jury-men or committee for examination were principally Frenchmen. No publication of their decisions or awards was made at the time, and I was informed by the horticultural director there would be none until after the close of the Exposition. Some of the exhibitions, especially in the floral section, were very creditable, and towards the latter portion of the season some good displays of fruits and vegetables were also made. Recurrent bimonthly exhibitions of fruits, flowers, and vegetables. The jurors and their reports.

EXHIBITIONS OF FLOWERS.

Exhibitions of flowers.

The following lists of articles exhibited were made from actual observation, and include only those which were specially fine and well grown, and which continued to appear the best of their kind during successive exhibitions, without regard as to whether they were new or old varieties.

Roses, Hybrid remontants.

Roses. Hybrid remontants.

Abel Carrière, large, full, very dark purple-crimson.
Albert Payé, large, full, clear carnation.
Alfred Colomb, large, full, brilliant red.
Antoine Mouton, large, full, bright, clear rose.
Antoine Ducher, full, bright red.
Baronne de Mesnard, medium, full, pure white
Baronne de Rothschild, large, full, fine form, clear rosy pink; the best of its color exhibited.
Baronne Haussmann, large, full, fine form, scarlet.
Boiëldieu, very large, brilliant cherry-red.

Exhibitions of flowers. Roses. Hybrid remontants.

Captain Christy, large, full, pale rose.
Charles Baltet, large full, bright rosy carmine.
Charles Lefébvre, large, full, cup form, brilliant, dark velvet-crimson.
Charles Margottin, large, fine form, brilliant carmine.
Cheshunt Hybrid, medium full, cherry-red.
Christine Nilsson, large, full, globular, bright rose.
Clovis, large, full, fine form, bright reddish purple.
Comtesse Cécile de Chabrillant, medium full, imbricated, fine form, delicate blush-rose.
Coquette des Alpes, medium full, fine form, pure white.
Coquette des Blanches, medium full, fine, pure white.
Comtesse de Châteaubriant, handsome blush-white.
Devienne Lamy, large, full, fine carmine-red.
Dingee Conard, large, very dark crimson.
Doctor Andry, large, full, carmine.
Duc de Cazes, medium full, purplish red.
Duc d'Edinburgh, large, full, bright crimson.
Duc de Montpensier, very large, full, red, shaded with dark carmine.
Duc de Wellington, large, full, brilliant velvet-red.
Duchesse de Magenta, medium full, fine white.
Duchesse de Norfolk, medium full, red.
Elisa Boëlle, large, full, fine form, blush-rose.
Elisabeth Vigneron, large, full, very fine, clear bright rose.
Empereur du Maroc, medium double, very dark violet-rose.
Étienne Levet, large, full, good form, rosy carmine.
Eugène Appert, large, fine form, brilliant, scarlet-crimson.
Eugènie Wilhelm, large, full, amaranth-red, shaded with very dark blackish maroon.
François Michelon, very large, full, dark rose.
General Washington, large, full, fine form, brilliant red.
Glorie de la France, large, double, crimson.
Hippolyte Jamain, very large, full, centifolia form, brilliant rosy carmine.
Jean Liabaud, large, full, velvet-crimson, shaded black.
Jean Soupert, large, velvet-purple.
John Hopper, large, full, briliant rose, carmine center.
Jules Margottin, large, full, imbricated, fine, rosy carmine.
Lion des Combats, large, double, dark crimson.
Lord Clyde, medium full, fine form, purplish red.
Lôuis Van Houtte, full, fine globular form, bright rose.
Lyonnais, large, full, delicate rose, darker center.
Mme. André Leroy, large, double, fine form, salmon-rose.
Mme. Boll, large, full, perfect form, bright rose.
Mme. Gustave Bonnet, medium full, white, delicate rose shade
Mme. Hippolyte Jamain, large, full, white, light rose shade.
Mme. Lacharme, large, double, white, shaded with rose.
Mme. Liabaud, large, full, white, carnation shade.
Mme. Marie Cirodde, medium full, bright, clear rose.
Mme. Marie Finger, large, full, globular, brilliant rose.
Mme. Victor Verdier, large, full, cupped, brilliant cherry-red.
Mme. Schwartz, large, fine, light rose.
Mlle. Alice Leroy, large, double, delicate rose, fine form.
Mlle. Marguerite de St. Amand, large, full, fine form, very clear light rose.
Mlle. Thérèse Levet, large, full, fine form, clear rose, carmine center.

Exhibitions of flowers. Roses. Hybrid remontants.

Mlle. Favart, medium, cupped, fine form, light rose.
Maréchal Vaillant, large, fine form, brilliant rosy purple.
Marie Baumann, medium, dark carmine.
Marie Duncan, medium, full, fine form, delicate rose.
Marquis de Castillane, large, full, fine form, brilliant rose.
Maurice Bernardin, large, imbricated, vermilion-red.
Mère de St. Louis, large, double, white-shaded rose, extra.
Mr. E. Y. Teas, large, full, brilliant dark red.
Noémie, fine, large double rose.
Olga Marix, medium full, fine white blush.
Paul Neyron, very large, full, dark rose, extra.
Paul Verdier, large, full, bright rose.
Pauline Talabot, large, convex, rosy carmine.
Perfection des Blanches, medium, fine form, pure white.
Prince Camille de Rohan, large, full, very dark-shaded crimson.
Princesse Blanche d'Orleans, large, full, bright rose.
Reynolds Hole, large, full, maroon-red, dark-shaded crimson.
Richard Wallace, large, fine, lively rose.
Senator Vaise, large, full, brilliant scarlet.
Souvenir d'Auguste Rivière, fine form, crimson scarlet.
Souvenir de John Gould Veitch, large, full, imbricated, dark crimson.
Souvenir de M. Rousseau, large, full, light crimson, rose center.
Souvenir de Spa, large, full, dark red, shaded scarlet.
Souvenir du Docteur Jamain, large, full, bluish violet, crimson-maroon shade.
Victor Trouillard, large, full, fine form, velvet crimson.
Virginal, large, full, fine form, white.
Wilhelm Neubert, large, full, dark cherry-red, shaded purple.
Xavier Olibo, large, full, good form, dark fiery red, shaded with almost black amaranth-maroon.

Roses, Tea.

Tea-roses.

Anna Olivier, large, full, blush-carnation.
Belle Lyonnaise, large, full, yellow, deep canary shade.
Bougère, very large, double, peculiar coppery rose.
Coquette de Lion, medium, good form, canary-yellow.
Devoniensis, large, double, yellowish white.
Glorie de Dijon, very large and double, good form, yellow shaded with salmon, extra.
Jean Pernet, very large, full, fine yellow, dark center.
Mme. Bravy, medium size, full, double, white.
Mme. Hippolyte Jamain, large, very full, good form, pure white, shaded coppery center.
Mme. Margottin, medium, full, globular, fine form, dark yellow.
Mme. Marie Van Houtte, large, full, good form, yellowish white.
Mme. Melanie Villermoz, large, double, white.
Mlle. Lazarine Poizeau, medium, full, bright red.
Maréchal Neil, very large, fine form, dark-shaded yellow.
Marie Guillot, large, full, inbricated, yellowish white.
Princesse Marie, medium, full, fine white.
Victor Pulliat, large, full, fine form, creamy white.

Roses, Bourbons, and Noisettes.

Bourbons and Noisettes.

Baron Gonella, large, full, fine form, white center, reverse of petals rose.
Héroïne de Vaucluse, large, full, globular, bright rose, striped with carmine.

Exhibitions of flowers.

Roses.

Bourbons and Noisettes.

Impératrice Eugènie, large, full, rosy lilac.
Louise Odier, large, full, fine form, clear rose.
Madeleine Choumer, medium, full, cup-form, blush-white, fine.
Reine des Iles-Bourbon, full, fine, cup-form, rosy salmon.
Souvenir de Malmaison, very large, full, blush-white.
Vicomte Fritz de Cussy, dark-shaded red.
Bouquet d'Or (Noisette), large, full, dark yellow.

Moss-roses.

Roses, Moss.

Mme. Edward Ory (remontant), medium, full, bright rosy carmine.
Héloïse, medium, double, bright red.
Reine Blanche, large, full, flat, pure white.

Single geraniums.

Geraniums, single.

Europa, dwarf habit, large flower, good form and substance, bright vermilion-scarlet.
Alabaster, medium size, pure white.
Fournaire, good form, dark cherry-red.
Pelleport, large flower and truss, brilliant orange-scarlet.
Coquette Suresnes, medium, red, blotched with white.
Éblouissant, nosegay, fine, large truss, brilliant red.
Laurence Chaté, large flower and truss, white.
Victor Hugo, large leaf, broad dark zone, brilliant vermilion.
L. Gauthier, fine dwarf habit, large truss, light cherry-scarlet, good flower.
M. Joseph Dubois, large flower and truss, very dark cherry-red.

Double geraniums.

Geraniums, double.

Francis Persusati, light salmon-pink, white edge.
Deputé Berlet, purplish rose, dwarf habit, good.
Mme. Thibaut, bright purplish crimson, free bloomer.
Victor Hugo, light red, salmon shade, good.
Léon Villard, deep cherry-red, very good.
Guillem Mangilli, semi-double, large truss, free bloomer, dark scarlet.
Senator Testelin, bright vermilion-red, good.
Mlle. Baltet, medium truss, thin petals, pure white.
Le Trouvère, large flower and truss, cherry-scarlet, opens well.
Boule du Bel Air, large truss, light orange-scarlet, fine.
Magali Reclus, full, round truss, clear rose, fine.
Mme. Lemoine, good flower and truss, bright rosy red.
La Marseillaise, large, fine truss, bright rosy pink.
Nymphe, good truss, handsome, pure white.
Norma, Rosette, and Vesta, were the names of three ivy-leaved geraniums, with double light-purple flowers, novel and quite pretty.

Pelargoniums.

Pelargoniums.

Boileau, petals clear rose, with white throat and white edges.
Camille Dumesnil, medium flower, free bloomer, white throat, lower petals rosy pink, upper petals rose, blotched and shaded with dark maroon, all edged with white.
Captain Raikes, large, semi-double, bright vermilion-scarlet, beautifully striped and variegated with dark shades of crimson-maroon, edged with white.

Émile Dupont, dark purple, large dark blotch on upper petals, smaller on lower ones. Exhibitions of flowers. Pelargoniums.

Gloire de France, large, fine truss, upper petals blotched and suffused with dark maroon and rosy crimson, lower petals spotted with the same.

Kingston Spa, large, clear white, with dark-purple blotch on upper petals, small crimson spot on lower ones.

Marie Casson, fine, large, white, purple blotch on upper petals.

Marie de Vandœuvre, clear, dark rose, with white throat and white edges.

M. Guerinais, large, full flower, brilliant crimson-scarlet, suffused, striped, and blotched with shades of purple maroon, extra.

Noël Adalbert Amand, scarlet crimson, edged with white, white throat.

Queen Victoria, large, fine flower, crimson-scarlet, black blotch white edge, crimped petals.

Regrets d'Amand Adalbert, large flower, very dark.

Taillade, fine form, dark rose, small blotch on upper petals, white edges.

Gladioli.

Gladioli.

There were several exhibitions of gladioli during the season; one of the finest I have ever seen, by Messrs. Vilmorin, Andrieux, & Co., August 2, mostly of old and well-known varieties. From this and other collections, the following list comprises the finest named varieties shown: Vilmorin, Andreux & Co.

Arsinoé.
Amalthée.
Aréthuse.
Ambroise Vershaffelt.
Antiope.
Anna.
Astrea.
Armide.
Albion.
Belladonna.
Béatrix.
Célimène.
Chloris.
Canova.
Carnation.
Crœsus.
Cybèle.
Conquête.
Daubenton.
Eugène Scribe.
Giganteus.
Horace.
Horace Vernet.
Hécla.
Jupiter.
Lulli.
Le Phare.
Le Vésuve.
La Candeur.
La France.
M. Legouvé.
Marie Stuart.
M. Broignart.
Mme. Krélage.
Niobé.
Norma.
Orphée.
Ondine.
Psyché.
Phœbus.
Panorama.
Princess Clotilde.
Pactole.
Reine Blanche.
Rosita.
Shakspeare.
Sirène.
Schiller.
Sir John Franklin.
Sémiramis.
Titania.
Urania.
Virginalis.
Vénus.
Zampa.

In addition to which there were some good new seedlings, but unnamed.

Exhibitions of flowers. Begonias.

Begonias.

Large collections of begonias were shown during the Exposition, both planted in the open ground and in the horticultural buildings, including the various kinds of large-leaved, tuberous-rooted, greenhouse and bedding varieties. Many new and unnamed kinds were among them, some having considerable merit. Among the new seedling begonias were some very pretty double varieties, one very remarkable, with eight rows of petals, brilliant orange-scarlet, by V. Lemoine. The following-named varieties were quite distinct and good:

Adrien Robine.
Arcturus.
Comtesse de Madaillac.
Inimitable.
Jules Dehaussy.
Keramis.
Le Brun.
Louise Chrétien.
Mme. Panhard.
Margaritacea.
Michael Ange.
Varsovie.
Victor Bleu.

Peonies.

Peonies.

Adelaïde Delache, large, double, shaded pink and rose.
Charles de Belleyme, imbricated, fine, dark crimson.
Charles Gosselin, white, flecked with red.
Doctor Brétonneau, large, double, open, deep rose.

Phloxes.

Phlox, perennial.

The following were fine and noticeably distinct among the exhibitions of perennial phloxes:

Céline Lavoust, cherry-red, dark-maroon eye.
Gidéon, bright, clear pink, crimson eye.
Lamartine, rosy lilac, edged with white, large crimson eye.
Léopoldine, white, crimson eye.
Liervallii, rosy crimson, striped with white.
Lepère, clear pink, large, shaded-crimson eye.
Mme. Domage, dwarf, cherry center, white edge.
Mme. J. Mandet, white, with crimson eye.
Mme. Pauchet, clear white, pink eye.
Mme. Schwartz, dwarf, large truss, pure white.
Némésis, light, clear rose, dark-crimson eye.
Oscar Beyer, rose, crimson eye.
Pandore, light lilac, dark-purple eye.
Roi des Blancs, dwarf, fine, pure white.
Duc de Wellington, large, fine, white.
James Odier, fine, white, pink shade.
Léonie, large, double, fine, white.
L'Illustration, fine, pointed petals, deep rose.
Léonie Callot, fine, white, pink blush.
Maréchal McMahon, dark crimson.
Solfatare, white, shaded with yellow.
Victor Lemoine, very dark crimson.

Exhibitions of flowers.

Iris.

Iris.

In a collection of about 30 varieties the following were the finest and quite distinct in character:

Aaron.
Chaméleon.
Cormai.
Julia.
Le Drapeau.
Minerve.
Proserpine.

Echeverias.

Echeverias.

L. Chaté exhibited about 100 varieties of echeverias, of which these named were most distinct:

Arachnoidcum forma.
gnaphalon (cluster).
Antarcticum.
Arvenense.
Arachnoides Arvenense.
Alpinum.
Barbaricum (maroon).
Bort gayanum.
Carnescens.
Cornutum.
Calcareum.
Glaucum.
Heuffeleii.
Hirtum.
Imbricatum.
Reginia amalia.
Rubicundum.
Rudeni.
Seleboni.
Tectorum.
Tectorum Neuilly.
Triste.
Umbilicum chrisanthum
Umbilicus spinulosus.
Ventosicolum.
Webbiana (cluster).

Clematis.

Clematis.

Several of the newer varieties of this beautiful climber were on exhibition and in bloom during the season, the following being among the best:

Atragène des Indes, small or medium-size flower, double, white, very pretty.
Cylindrica, medium, bell-shaped flower, light purple, with dark stripe in center of each petal.
Gloire de St. Julien, large flower, broad petals, free bloomer, strong grower, rich dark purple.
Integrifolia Durand, large flower, medium narrow petals, handsome azure-blue.
Jackmanii, an old but one of the best varieties, large flower, bright reddish purple.
Jeanne d'Arc, large flower, very light purple.
Lady Caroline Neville, very large, about twice the size of Jackmanii, light purplish lilac, with dark stripe through the center of each petal, very fine.
Lanuginosa Nivea, very fine, large white flower.
Lucie Lemoine, double, fine.
Magnifica, very large flower; broad petal, light reddish purple.
Marie Dufosses, very large flower, 5″ in diameter, light lilac.
Rubella, fine, large flower, very abundant bloom, dark, rich purple.
Thunbridgensis, large, bright purple.
Velutina Purpurea, medium size, dark velvet, purple.
Viticella Modesta, resembles Jackmanii, but rather lighter in color.
Viticella Venosa, large, dark purple flower, with light stripe through center of each petal, giving the flower a star-like appearance.

Exhibitions of flowers. Climbers.

Climbers.

In a collection of climbing plants, of various kinds, I found the following, which were good:

Ampelopsis hirsuta.
cordata.
hederacea.
Rhincospermum variegata alba.
variegata aurea.
scandens.
Rhincospermum jasminoides.
Solanum variegatum.
jasminifolia.
Smilax aspera.
laurifolia.
tamnoides.

With also some handsome passifloras and honeysuckles.

Gloxinias.

Gloxinias.

Some large collections of this beautiful flower were exhibited, both of named varieties and new seedlings. J. Vallerand had about 100 varieties. I noted the following as specially fine:

Girandole.
La France.
Le Charmeur.
Mme. Duval.
Mme. Pinaud.
Mignonette.
M. Pygmy.
Richard Wallace.
Roi de Suède.
Sang Gaulois.

Some of the unnamed seedling varieties of 1877–'78 were also very good.

Cycads.

Cycads.

The following handsome collection of cycads was exhibited in June, in large tubs. They were all large and finely-grown specimens.

Balantium antarcticum (18′ high, 12′ spread.
Cycas circinalis.
circinalis glauca.
Ceratozamia Mexicana.
Cycas Nordmandiana.
revoluta.
media.
Riuminiana.
Dion edule.
Encephalartos caffre.
Encephalartos Vroomii.
altenstemii.
vernicosa.
Macrozamia Fraserii.
coralipes.
Zamia Ghellinckii.
Lindenii.
villosa amplicata.
horrida.
cycadœfolia.

Palms, musas, &c.

In addition to the above, there were also many fine specimens of palms, musas, and cycads, in many parts of the Exposition grounds; some planted in open ground, others in large tubs.

Aloes.

Two large aloes, or century plants, in bloom, stood near the entrance to the building of the Principality of Monaco.

Commoner flowers.

There were also exhibited, in their season, in the horticultural buildings, fine collections of the more common flowers, in great variety, including asters, balsams, carnations, dahlias, godetias, hollyhocks, larkspurs, pansies, do-

tentillas, phlox, zinnias, etc., but which scarcely require further notice.

Variegated trees and shrubs.

Among variegated leaved trees and shrubs, *Negundo argentea*, or silver-leaved maple; *Tilia argentea*, or silver-leaved linden; several of the newly-introduced Japanese maples, including *Acer Japonicum*, *A. atropurpurea*, *A. Lorbergii*, *A. palmatifidum*, *A. palmatum*, *A. platanoides Schrœdlerii*, *A. reticulatum*, *A. sanguineum*, and others; *Euonymus aurea* and *argentea*; *Weigela rosea, fol. variegata*; *Cissis vitiginea*, a handsome variegated-leaved climber, were noticeable and pretty.

EXHIBITION OF FRUITS AND VEGETABLES.

Exhibitions of fruits and vegetables.

Displays of fruits and vegetables were made in the horticultural buildings at the same times that the flowers were exhibited; and although the exhibitions in these departments were not generally very remarkable, either for variety or quantity, there were some articles exhibited, especially in vegetables, of great excellence.

Strawberries.

Strawberries.

Strawberries were on exhibition early in June, about 50 varieties, in pots, large and well grown. The most notable for large size were:

Aglaé de Bernet.	Mme. Charles.
Bertha Montjoie.	Muscadine de Liége.
Dr. Morère.	Mme. Nicaise.
Dr. Nicaise.	Pulchra.
Hébé.	Professor Pynaert.
Joseph Riffaut.	Reine de Noir.
La Favorite.	Sabreur.
Marguerite.	Myatt's Surprise.

As a rule, the largest varieties seemed less prolific than those of smaller size. But of the above list, Dr. Morère, Mme. Charles, Marguerite, and Muscadine de Liége were quite prolific, as well as very large. The following were very prolific, but somewhat less in size:

Auguste Nicaise.	Newton Seedling.
L'Exposant.	Président de la Cœur.
Mme. Charles de Cazanove.	Victoria.

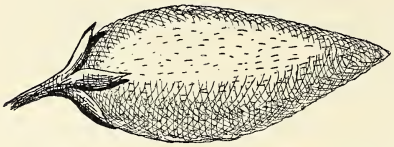
In after exhibitions Dr. Morère and Marguerite appeared the finest of all. Brown's Wonder, Monsieur Fournier (very dark), and Prince Arthur were very handsome. Sir Joseph Paxton and Jucunda were also on exhibition; large and handsome, about equal in appearance.

Alpines.

The white and red Alpine or perpetual strawberries were also on exhibition during the whole season, but contained

Exhibitions of fruits. Strawberries.

nothing remarkable, unless a variety called "Fraise Duru" (Fig. 22), and claimed to be a new seedling, may prove valuable. It was on exhibition every month from June till October. A long, pointed berry of deep red color and large size for an Alpine. Whether its size and appearance were due to extraordinary cultivation I could not ascertain. It appeared somewhat like the "Mexican ever-bearing" strawberry, which was introduced in the United States some years since, but which proved nearly worthless for general use.



Fraise Duru. FIG. 22.—"*Fraise Duru*" (*average size*).

Cherries.

Cherries.

Cherries were exhibited in limited quantities and in but few varieties. They were, however, of remarkable excellence; large, finely colored, and high flavored. The early exhibitions were from Italy, mostly from the region of Turin. Among a collection from Vallée d'Aulnay, à Sceaux (Seine), I noticed Governor Wood, one of the late Dr. Kirtland's seedlings, originated at Rockport, Ohio, labeled as an *English* variety, with highest commendation for quality and productiveness. In June, the handsomest varieties shown were Bigarreau des Confiseurs, very large, yellow, with red cheek, and Bigarreau Rouge, beautiful, bright, dark red. In August, Archduke, Belle Magnifique, and Napoléon Bigarreau were among the finest. The markets of Paris also seemed well supplied with cherries of fine quality during the season, but many of them were brought by railway from Germany and Italy.

Plums.

Plums.

Plums were shown in great variety and of very fine quality. The curculio, which is so destructive to the plum in America, does not seem to prevail in France; certainly not to any injurious extent. The principal exhibitions were made on the 1st and the 15th of August. Among the finest were the following kinds:

Abricot.
Abricotée Jaune.
Altesse.
Abricotée Blanche.
Autumn Compote.
Albany Beauty.
Anna Lawson.
Blanche de Palermo.
Bingham.
Bleu de Belgique.
Coe's Golden Drop.
Drap d'Or Espéren.
Dame Aubert.
Damas Anderka.
Dame Victoria.
Damas Violet des Carmelites.
Damas de Maugeron.
Damas Noir.

Damas de Septembre.
Des Bijounières.
Early Prolific.
Golden Gage.
Goliath.
Hazard.
Imperial Gage.
Impérial de Milan.
Impérial Ottoman.
Jacinthe.
Jérusalem Jaune.
Jefferson.
Kirk's Plum.
Lafayette.
Lucas Frühe Zwetsche.
Merveille de Septembre.
Merigon.
Monsieur Hatif.
Monsieur Jaune.
Monsieur.
Montfort.
MacLaughlin.
Mirabelle Gros.
Mitchelson.
Perdrigion Rouge.
Perdrigion Violet Hatif.
Petite Mirabelle.
Pond's Seedling.
Pont Brillant.
Poire.
Quetsche Eugène Furst.
Reine Claude de Bavay.
Reizenstein Jaune.
Reine Claude Diaphane.
Reine Claude Rouge.
Reine Claude Donée.
Reine Claude Précoce.
Royal Hative.
Royal de Behrens.
Reine Victoria.
Reine Claude.
Royal Lucas.
Smith's Orleans.
St. Étienne.
Violette Américaine.
Violette Impériale.
Virginale Blanche.
Washington.
Washington Purple.

Exhibitions of fruits.

The variety named Merigon is a new seedling, which will be offered for sale in autumn of 1879. It is of enormous size, nearly black in color, oval or egg-shaped, and as large as large hen's eggs. It is, however, rather coarse in texture, and not above third rate in quality. Some members of the French jury pronounced it as "very poor" in quality.

The Merigon.

A handsome specimen plant of a prune named Diadem, about 3′ high, was exhibited in a 10″ pot, bearing 19 large prunes.

Peaches.

Peaches.

Peaches were shown in a few varieties from Italy and from Montreuil, July 16—Early Beatrice and Précoce de Halle (Hale's Early), and Reine des Vergers. Some Early Beatrice grown in pots were very fine. Afterward, during the season, small collections were exhibited, generally remarkably well grown and highly colored, from various sources in the vicinity of Paris; also from Nice and Turin. The peaches exhibited were mostly grown as specimens, on walls or in pots under glass. The following were the principal and best varieties:

Abricot (very large).
Belle Cartière.
Belle de Vitry.
Belle Bausse.
Belle Impériale.
Bon Ouvrier.
Bourdine.
Bernardin de St. Pierre.
Brindeau.
Chancellor.

Exhibitions of fruits.

Chevreuse.
Crawford's Early.
Du Prado.
Egypt.
Early Beatrice.
Early Louise.
Early Rivers.
Gallande Pointue.

Peaches.

Gregory's Late.
Grosse Mignonne.
Grosse Mignonne Hative.
Impériale Eugènie.
Leopold I.
Mme. Lassaque.
Madeleine Blanche.
Madeleine Courson.
Madeleine Jaune.
Malta.
Mignonne Tardive.
Madeleine Jaune de Bordeaux.
Noblesse.
Noir de Montreuil.
Pavie Blanc.
Pavie Jaune Précoce.
Pêche Jaune.
Précoce de Halle (Hale's Early?).
Princess of Wales.
Reine des Vergers.
Salway.
Sieulle.
Tardive Lepère.
Téton de Vénus.
Verte de Beaulieu.
Ward's Late Free.
Walburton Admirable.
Yellow Admirable.

Nectarines.

Nectarines.

Blanc.
Brugnon Violet.
De Feligny.
Jaune Pitmaston.
Lord Napier.
Newington.
Violet Hatif.

Apricots.

Apricots.

Apricots were also exhibited in considerable quantity, but all, or nearly all, were of one variety, the peach apricot. The peaches and nectarines, as well as the apricots, although well grown, of large size, and beautifully colored, were not as high flavored as the same varieties grown in the United States, probably on account of much rain and a lower average temperature in summer.

Apples.

Apples.

The exhibitions of apples throughout the season were rather small, and as a rule not of superior excellence. One of the best collections was shown at Versailles, at an international exhibition on the 24th of August—25 varieties, large and handsome, from Turin, and about 100 plates from different sections of France, ranging from medium to poor in appearance. The greater portion of the apples were of varieties not in general cultivation in the United States. The best collection of apples at the Exposition horticultural buildings was shown on the 15th of September, when there were about 100 plates, many varieties smooth and well

Noble de Bordort.

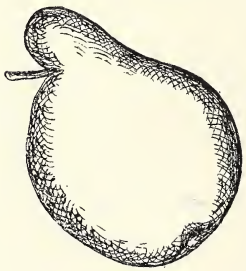


FIG. 23.—*Apple, Noble de Bordort.*

colored. The following were among the best exhibited during the season: Exhibitions of fruits.

Alfriston.
Alexander.
Antonowka (Polish).
Beauty of Kent.
Belle de Choler.
Bihout.
Belle Dubois.
Bolwiller.
Borowicki.
Calville Blanc.
Calville d'Été.
Calville Garibaldi.
Calville Marbré.
Canterbury.
Celini Pippin.
Count Orloff.
Duchowoje (Polish).
Early Joe.
Early Romanite.
Écarlate.
Fraise.
Golden Drop.
Grand Alexander.
Gravenstein.
Hawthornden.
Huntingdon.
Jaques Lebelle.
Langton.
Lord Suffield.
Marguerite.
Noble de Bordort, a very curiously shaped apple, quite uniform (Fig. 23). Apples.
Nonpareil.
Oslin.
Passe Pomme.
Pierre le Grand.
Rambourg (*Rambo?*).
Rambourg d'Été.
Red Astrachan.
Reinette Blanche de Canada.
Reinette d'Espagne.
Reinette Hollande.
Robin.
Sugar-loaf Pippin.
Summer Golden Pippin.
Surprise d'Été.
Titowska (Polish).
Transparent d'Astrachan (white).
Transparent Blanche.
Transparent de Croncels.
Transparent Rouge.
Vermilion d'Été.
Violette.
Williams.

Pears. Pears.

Pears were exhibited in great variety and in considerable quantities, although the season was apparently unfavorable for pear culture in the neighborhood of Paris. Many trees were not bearing, and the markets were not well supplied. Many of the pear trees in the Exposition grounds, which had been transplanted in March and April, bore handsome crops, and ripened their fruit apparently as well as if they had not been moved. I noticed a Beurre d'Amanlis pear tree trained "en espalier," about 8′ high, with 37 large and well-grown pears. The first pears exhibited in July were Beurre Giffard, Citron des Carmes, Épargne, and Madeleine. Of the large number exhibited the following were noticeable for fine size and handsome appearance:

Adèle Lancelot.
André Desportes.
Auguste Jurie.
Bartlett.
Barbincinet.
Belle Angevine.
Belle de Bruxelles.
Belle de Berri.
Beurre d'Amanlis.
Beurre Clairgeau.
Beurre Diel.
Beurre d'Ezée.
Beurre Gris.
Beurre Goubault.

Exhibitions of fruits.

Pears.

Beurre d'Hardenpont.
Beurre Hardy.
Beurre Magnifique.
Beurre Six.
Bergamot d'Été.
Blanquet Anastère.
Blanquet Gros.
Briffaut.
Calebasse.
Catillac.
Clapp's Favorite.
Colmar d'Aremberg.
Colmar d'Été.
Conseille de la Cour.
Delices d'Angers.
De Tongres.
Doyenne Boussock.
Doyenne du Cornice.
Doyenne d'Hiver.
Doyenne Jaune d'Été.
Doyenne de Merode.
Doyenne St. Michel.
Doyenne St. Roch.
Duchesse d'Angoulême.
Duchesse de Berry.
Épignard.
Fondante du Bois.
Général Totleben.
Howell.
Le Brun.
Louise Bonne d'Avranches.
Luçon.
Madeleine d'Angers.
Monchallard.
Nouveau Poiteau.
Passe Colmar.
Petit Blanquet.
Petite Marguerite.
Président Van Mons.
Triomphe de Jodoigne.
Van Marum.
William.

There were on exhibition, the middle of September, some very fine collections of pears:

160 plates and baskets from the School of Horticulture of Versailles.

75 varieties of pears and apples from the arboriculturists of Montreuil.

23 varieties of pears, of immense size, perfect and well colored, from "Gallion, at Avigny."

200 varieties of pears and 115 of apples, from S. Nicolar, of Igny.

41 varieties from Turin, mostly with local or strange Italian names.

Several smaller collections were also shown during the season, not specially remarkable. Antoine Besson, of Marseilles, was a large exhibitor of various kinds of fruits, among which were 100 varieties of pears.

Grapes.

Grapes.

The exhibitions of grapes were large, varied, and interesting, and held a prominent place throughout the season, as the production of grapes, both for the table and for the manufacture of wine, is one of the most important horticultural industries of France. In addition to the large collections of varieties which were brought to the Exposition buildings from time to time and shown upon plates, in baskets, and in clusters upon the branches, there were growing vines, both in open ground and in houses of glass constructed specially for that purpose. Some handsome and well-grown collections of bearing vines in pots were also

shown during July, August, and September. The principal exhibitions of grapes growing in large pots were from— Exhibitions of fruits.

M. Étienne Salomon, a large grape-grower of Thomery.

The School of Horticulture of Versailles.

Rose Charmeux and J. Margottin, *fils*, from near Paris.

Auguste Roy, of Paris, exhibited 50 varieties of grapes in plates.

Antoine Besson, of Marseilles, 230, including several American varieties, among which were Clinton, Cunningham, Delaware, Jaquez, and some others. Grapes.

In this collection were some immense bunches of red and white Malaga grapes, also specimens of the curious variety called Cornichons, both white and violet in color; they are of a large size, and in shape much like a small cucumber. The following six varieties were exhibited, finely grown, in pots, apparently well ripened, on the 1st of July:

Black Hamburgh, Black Prince, Foster's Seedling, Frankenthal, Hamburgh Doré, and Mill Hill Hamburgh.

The following were among the principal exhibitions during the remainder of the season:

Black Alicante.
Black Muscat.
Blanc de Courtillier
Bondales.
Bowood Muscat.
Cannon Hall Muscat.
Chasselas Blanc.
Chasselas Blanc de Thomery.
Chasselas Doré.
Chasselas de Montauban.
Chasselas Rose.
Chasselas Rose Royal.
Chavoust.
Cornichon Blanc.
Diamant Straube.
Duc de Magenta.
Général de Marmora.
Golden Hamburgh.
Gromier.
Gros Coulard.
Grosse Perle.
Hative Gêne.
Lady Downes.
Madeleine Blanche Royale.
Madeleine Précoce.
Madresfield Court Muscat.
Malingre.
Marbais.
Mascara.
Muscat of Alexandria.
Muscat d'Astrakan.
Morillon du Luxembourg
Muscat Noir.
Muscat St. Laurent.
Mrs. Pince's Black.
Mrs. Pince's Muscat.
Nivette Blanche.
Noir Hatif Marseille.
Pearson's Golden Queen.
Précoce Malingre.
Précoce de Saumur
Reveliotte.
Ribier.
Ronsard.
Rose Chasselas.
Rose du Roussillon.
Roumania.
Royal Ascot.
Royal Madeleine.
Royal Vineyard.
St. Albans.
St. Marie.
Tchaous.
Trebbiano.
West's St. Peter's.
White Tokay.

The vines in pots were trained mostly in spiral forms, and seemed very productive and well ripened. Figs. 24–26 Vines in pots.

Exhibitions of fruits.

show some of the most frequent styles of growing and training in pots. That shown in Fig. 24 has a single coil of

FIG. 24.

FIG. 25.

FIG. 26.

Grapes in pots.

Vines in pots.

the main branch, from which upright-bearing shoots are trained to stakes around the circumference of the pot; the second and third, different modes of training the main

Spiral training.

branch in spiral form, from which fruit spurs were allowed to grow along the entire length. There were also appliances for keeping grapes fresh for some time after being cut from the vines. They were usually of circular form, arranged so as to accommodate as many clusters as possible in circular rows, one above the other, each cluster cut with a piece of the branch 6″ long below, which was inserted in a tube filled with water. These tubes were arranged in a frame-work just far enough apart to keep the clusters of grapes from touching, and I saw grapes kept looking fresh for several weeks, by this method.

Grape glasses.

The accompanying drawing (Fig. 27) will give an idea of the manner of cutting the grapes, and of placing them in the tubes. The frame-work holding the tubes may be made of any convenient form. A similar method of keeping roses for exhibition seemed very effective and useful. A long tin cylinder (Fig. 28), with upright small tubes into which the stems of roses or other cut flowers were inserted, the whole being filled with water, kept them fresh for some time.

FIG. 27.—*Grape glass.*

Flower glasses.

A succession of these cylinders upon an inclined upright frame, when filled with different varieties of roses, had a very good effect, and afforded an excellent opportunity for observation and comparison of the kinds exhibited.

A plain, small greenhouse (Fig. 29), 10′ wide and about 45′ long, with frames and sash of iron, stood near the horti- Flower glasses.

FIG. 28.—*Tube for displaying and preserving cut flowers.*

cultural buildings in the Exposition grounds. All the sash, both upper and lower, were hinged, and any or all could be opened more or less for ventilation, or other purposes, as occasion might require. The house was used for a cold-vinery by Mr. Étienne Salomon, of Thomery, and was filled Iron frame greenhouse.

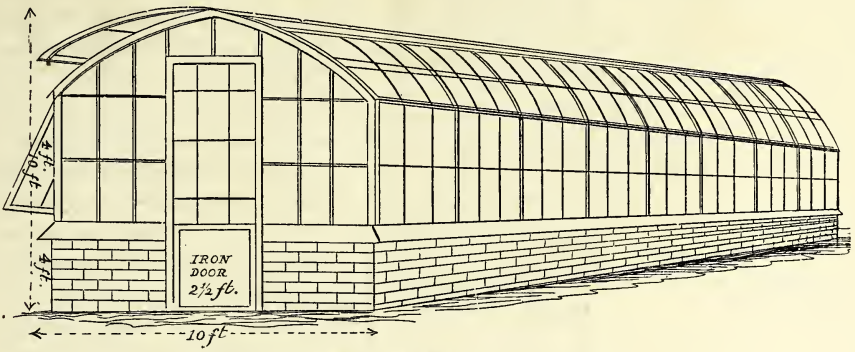
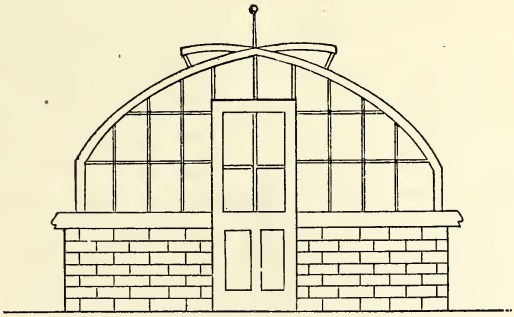


FIG. 29.—*Small greenhouse with iron frame.*

with various sorts of grape vines closely planted, about 3′ apart, in borders 3′ wide, filled to the level of the stone coping which surmounted the brick-work which formed the foundation of the house. These vines, 30 in number, were 3 years old, and were planted in this house in March. They were all bearing handsomely from 7 to 10 clusters each, and Cold vinery.



Width 12′, height 8′.

FIG. 30.—*Small greenhouse; wooden frames and sash.*

Wooden frame greenhouse.

were well advanced towards maturity July 25 following. A row of younger vines, not in bearing, were planted in

Greenhouses and vineries.

open air along one side of this house, trained upon a low wire trellis. They did not present as healthy an appearance as the vines under glass, and required the application of sulphur several times during the season as a protection from *oidium*, or mildew of the foliage.

Greenhouse with pavilion.

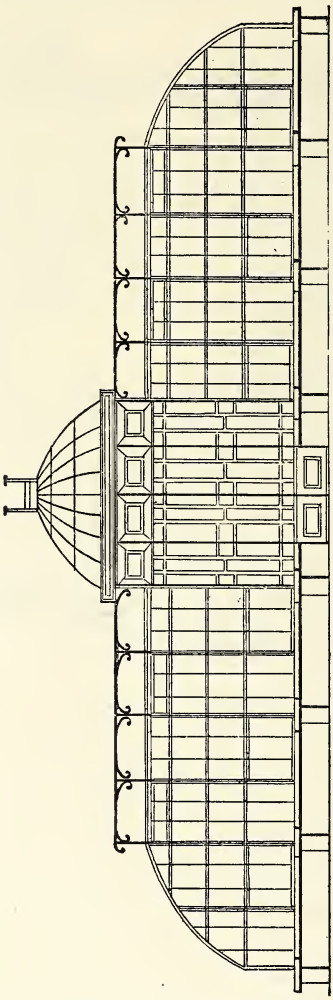


FIG. 31.—*Model of greenhouse, with pavilion; iron frame and sash.*

The greenhouse Figure 29, was one of the cheapest and simplest on the grounds; but being built of iron, glass, and stone would be very durable. Another, somewhat larger, but of similar construction, built of wood, seemed desirable when efficiency and economy were considered. In this house (Fig. 30) only the lower sashes were movable, upper ventilation being accomplished by small movable sashes at the top. These houses could be used with or without heating apparatus, and made of any desired length.

Besides these comparatively cheap and simple green-houses, there were many others very expensive and elaborate, some circular, dome-shaped structures, and other fanciful shapes, of iron and glass, very ornamental, but practically no more valuable than the more simple and less expensive forms. Fig. 31 represents one of those structures which was on exhibition among others much more ornate.

Lean-to greenhouse.

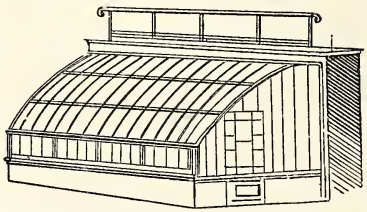


FIG. 32.—*Lean-to or side-wall greenhouse.*

Fig. 32 represents a small lean-to glass structure, suited for side walls or similar situations; Fig. 33, a hot-bed frame, with light iron sash, which seemed very convenient and durable. Fig. 34 is an ornamental greenhouse, by M. Michàux. The central pavil-

ion is square, with rounded corners, 25′ square, 22′ high; the two ends each 50′ long, 17′ wide, 12′ high. Divided inside into three compartments, to accommodate different varieties of plants. A graceful and elegant structure. A small model (Fig. 35) was exhibited to illustrate the advantages of curved glass for the upper portion of glass structures, in preventing injury by the action of rainfall upon the putty used for glazing. The sash were made of iron, the glass bedded in putty, with the curved side downward. In some cases, the putty was painted with white-lead paint, extending in a narrow line down upon the edges of the glass, and then covered entirely with strips of tin-foil, the white lead causing it to adhere very closely, and to make the glazing quite water-tight. The curved form of the glass would cause the rain to run away from the sash-bars and to the center of the panes, thus greatly lessening the effects of moisture upon the putty, and rendering the structure much more lasting and durable.

Ornamental greenhouse, Fig. 34.

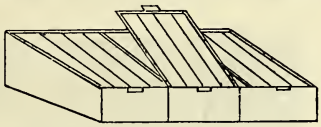


FIG. 33.—*Hot-bed; iron sash.*

Hot-bed frame.

Curved glass sash for hot-beds.

FIG. 35.—*Curved-glass sash for hot-beds.*

In addition to the grapes heretofore mentioned, the most of which were grown under glass and upon protected walls, there were exhibited, the middle of September, a collection of the small black, white, and red vineyard grapes from the region of Argenteuil, from which the wines of that section are made. Gamay Rouge is a small red grape about the size of the Delaware grape, and in appearance much like it. Gamay Noir is black, and in size and general appearance like the Clinton. Gouait Blanc and Meillet Vert are both light-colored grapes, about the size of Martha. The Gamay Noir makes the red wine of Argenteuil. They were all rather acid to the taste and appeared hardly ripe. In character and flavor they resembled the Alvey, more than any other American variety.

Argenteuil grapes.

"Gamay."

Some very handsome collections of fruits were brought from Italy, principally from Turin and from Rome. There were very fine oranges, lemons, and figs, peaches, apricots, and fine plums; almonds, apples, and pears were on the exhibition tables on the 1st of July. On the 15th of August, besides immense oranges and lemons, there were fine quinces and medlars, 12 varieties of grapes, melons, apples, pears, and figs.

Italian fruits.

Michaux's ornamental greenhouse.

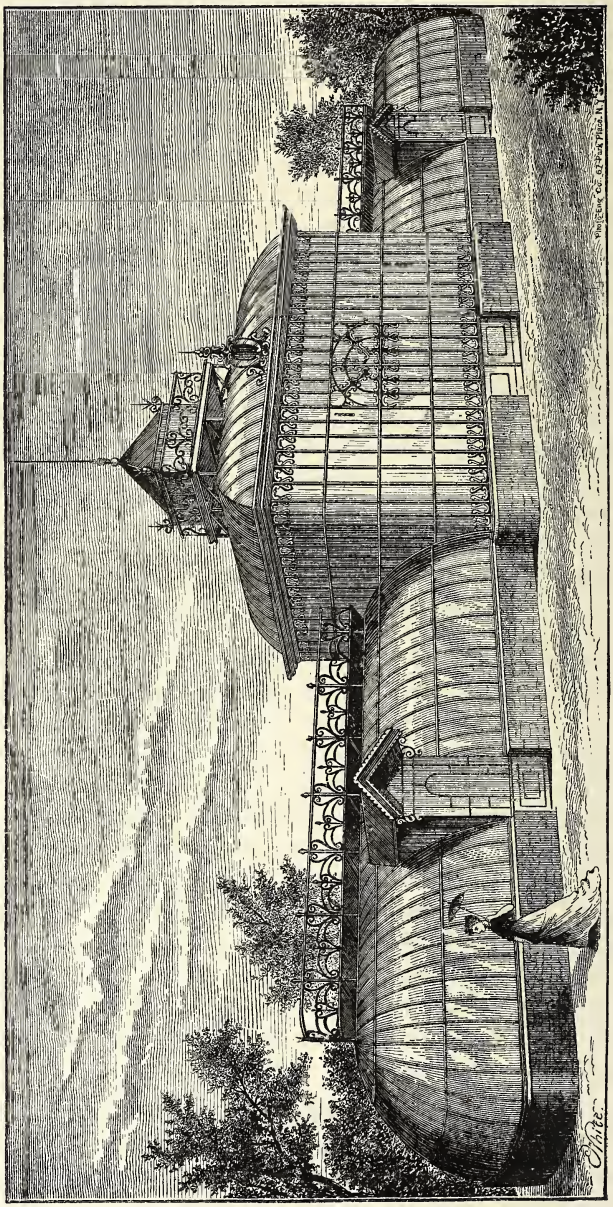


FIG. 34.—*Model ornamental greenhouse, designed by M. Michaux. From the "Bon Jardinier."*

A small collection of apples and pears, about a dozen kinds of each, not named, were exhibited in fair condition, brought from Victoria, Australia. Exhibitions of fruits. Australian fruits.

Figs. Figs.

Figs are quite extensively grown in the vicinity of Paris, and collections of the fresh fruit were exhibited throughout the season, both growing in large pots and boxes and upon cut branches; also in baskets. They are cultivated successfully in open air by planting the trees in a sloping position, so that they can be bent down and fastened to the ground and covered with earth during winter; a plan adopted long since by General Worthington, at Chillicothe, Ohio. The trees are kept rather low, and the pruning and training is always with reference to this winter covering for protection. Sometimes two trees are planted together, sloping different ways, and sometimes they are trained in four sections, appearing in the form of a cross when covered for winter. A shallow trench is usually cut from the base of the tree in the direction it is to be laid down, the branches tied in a bundle and bent down into the trench; a little mound of earth covers all safely during winter, and is removed early in spring. This mode of culture would doubtless succeed in the Middle and Southern States of the Union. The varieties which seem most approved are a dark purple named Violette Dauphin and a light yellowish-green sort called Blanche d'Argenteuil. Both these sorts were large and handsome, and they also appeared to be very prolific.

Raspberries. Raspberries.

Raspberries were exhibited in moderate quantity, the middle of July. Of those shown, Hornet and Pilatre were large and handsome, the best of all. Blanche Ordinaire was also noticeably good; Souchette, Fastolff, and Gambon, medium; Belle de Fontenay, inferior.

Currants. Currants.

In a collection of currants exhibited the Cherry currant was the largest and handsomest red; Impériale Blanche the finest white variety. Blanche de Hollande, another white sort, was also very good.

Models of fruits. Models of fruits.

Very large and interesting exhibits of models of the fruits of France were made by the "*Société Centrale d'Hor-*

Exhibitions of fruits.

ticulture de la Seine Inférieure" and the *"Société Centrale d'Horticulture de France."* These fruits were remarkably well executed, in natural colors, and were carefully classified as to their uses as well as time of ripening, and conveniently arranged and labeled upon shelves in glass cases along one side of the horticultural building. There were of pears for the table, 426 varieties, season from July to March; 34 new varieties of promise obtained from seed by members of the societies; and 85 sorts of pears for cooking. Of table apples, 238; cider apples, 425; and of new varieties, 6. The cider apples had been nearly all analyzed, named, and labeled with a card to each, giving its prominent characteristics. I copied one as a specimen:

Models of fruits.

Girard.—Fruit sweet, very good; cider agreeable; ripe for press, 1st to 15th of October; juice high-colored, perfumed; density, 1075; alcohol, 10 per cent.; alcoholizable sugar, 175 gr. per kilo.; tannin, 2.754. Tree very fertile, but not disposed to overbear.

There were also 36 models of new varieties of cider apples not yet analyzed, 19 varieties of peaches, 7 of apricots, 40 of cherries, 32 of plums, and 2 of quinces.

Models of American fruits.

There was also in the United States department, under charge of Dr. McMurtrie, a large collection of handsomely modeled fruits, principally of apples and pears, from the Department of Agriculture of the United States, which attracted much attention, and created considerable interest and inquiry among fruit-growers about the apples grown in America.

Department of Agriculture.

Exhibitions of vegetables.

VEGETABLES.

In connection with the exhibitions of fruits, and in the same buildings, semi-monthly exhibitions of vegetables were also made, and although, as a rule, the exhibits were not very large, they were generally excellent in quality, the specimens well grown, and apparently the best of their kind. Especially commendable were the large displays of asparagus, salad plants of various kinds, cauliflowers, cabbages, radishes, etc., showing great care and skill on the part of the French gardeners.

Asparagus.

Asparagus.

The growth and culture of asparagus is regarded by the French people as among the most important of their horticultural industries, and during the early part of the season no vegetable is more abundant in their markets, greengrocers' shops, or in the carts of vegetable venders upon

the streets. It is not less remarkable for extraordinary size and quality than for quantity. Specimen stalks were brought into the Exposition, perfectly blanched, 9″ to 10″ long and 6″ in circumference. This, of course, was exceptionally large, but there were plenty of bunches in the markets the stalks of which would average 1″ in diameter or 3″ in circumference. They claim to have two or three distinct varieties, among which the Early Argenteuil and the Late Argenteuil are considered the best for general use. Large portions of ground are given up to the asparagus beds in the neighborhood of Paris and Fontainebleau. It is also grown as a supplementary crop between the rows of vines in vineyards. For winter use it is forced in hot-beds or in glass structures heated with hot-water pipes. In open-air culture, the roots are planted in trenches about 9″ below the surface; these trenches are filled with manure and rich fine earth, in successive years, as the roots and plants increase in size and strength, and when the beds are fully established the crowns of the plants are 8″ or 9″ below the surface of the ground. The asparagus is always cut 6″ or 8″ under ground, and when the tips are about 1″ above the surface, and the more perfectly the stalks are blanched the more highly it is esteemed. Small and green asparagus is regarded as very inferior, and only sells at a low price, and is used principally in soups. Something may be due to improved varieties, but the principal reason for the extraordinary size and excellence of the French asparagus will be found in skillful culture, giving the plants plenty of room, and an annual dressing of rich compost.

Exhibitions of vegetables.
Asparagus.
Large size.
Varieties.
Mode of growing.

Cauliflowers.

Cauliflowers.

Cauliflowers of great excellence were also exhibited in considerable quantities during the season. On the 15th of June, very fine large heads of Early Paris, Half-early Paris, and Le Normand cauliflowers were on the tables, from seed sown in January. Another variety, named Salomon, with very large, white, and compact heads, was exhibited July 1. This is another vegetable which is largely grown and used by the French people, and with which the markets were abundantly supplied. The varieties named above are among the best.

Cabbages.

Cabbages.

Cabbages were exhibited in greater variety. Of early kinds, or those exhibited July 1, Petite Hative Erfurt and

Exhibitions of vegetables.

Gros Tardif seemed the finest. Cobus du Bonhomme was also a large, round-headed, solid variety. Choux de Milan, an enormous Savoy or wrinkled cabbage, was shown August 15.

Lettuce.

Lettuce.

Lettuce, the great salad plant of the French gardens, appeared also in considerable variety and of remarkable excellence throughout the season. This is said to be never absent from the French markets, and extraordinary means are used to have it in perfection at all seasons. By successive plantings of varieties adapted to the season, and the use of hot-beds and bell-glasses, fine lettuce is produced by the French gardeners throughout the whole year. Of about 30 varieties exhibited, the following appeared noticeably the best:

Blonde de Versailles.	Grosse Brune Paresseuse.
Chou de Naples.	Grise Maraichère.
Friser à Couper (a curious variety with fringed leaves).	Gros Normandie.
	Impériale.
Gros Blonde d'Été.	Rouge d'Hiver.
Grosse Blonde d'Hiver.	Rouge Pomme de Maraichère.
Grosse Blonde Paresseuse.	Verte Maraichère.

"Petit Noir."

The variety most largely grown for winter use is a medium-sized, hardy lettuce, called Petit Noir, which has the remarkable quality of growing best in a closely confined atmosphere, in a tight frame, or under a close "*cloche*" or large bell-glass, which is so much used in French gardening.

Corn-salad, chicory, endive, Swiss chards, water-cresses, and other salad plants are also used to greater or less extent.

Potatoes.

Potatoes.

American varieties.

Several large collections of potatoes were exhibited, the most of which were of English and French origin. Some American varieties were shown, and they certainly compared favorably with the finest specimens from other countries. It was noticeable that in every collection, however small, the Early Rose was always present, showing that it is a favorite with the French gardeners as well as at home. As a rule, the English and French varieties exhibited were small and inferior in appearance; in this respect, far below any similar exhibitions I have ever seen in the United States. Among those exhibited July 1, were Brownell's Beauty, Compton's Surprise, Early Rose, Early Vermont, and a very handsome early forcing French variety named Premières, an oblong, smooth, white potato of good size,

"Early Rose."

and one of the finest in appearance of the foreign kinds exhibited. At another exhibition, August 15, in addition to those above named, appeared: Exhibitions of vegetables.

Potatoes.

Chardon.	Printanière.
Confédéré.	Roi des Flukes.
Early Peachblow.	Saucisson.
Eureka.	Vanderveer.
Farineuse Rouge.	Vaugienne tardive.
Merveilleuse d'Amérique.	

All of which were of good size and handsome.

Carrots. Carrots.

A small, early variety of the carrot, called French forcing carrot, which is rarely seen in American markets, is very largely cultivated, and appears in the French markets at all seasons. The roots are nearly round, and would not average more than two inches in diameter. They grow rapidly, have a very small, slender top or leaf stalk, and can therefore be planted very close. They are of a light-orange color, and, when cooked, quite tender and delicate, though of no very decided flavor; and I should judge the taste of most persons would require some "education" to appreciate it very highly.

Artichokes. Artichokes.

Globe artichokes were exhibited in fourteen varieties, June 15. This is another vegetable but little used in the United States, but very largely grown in France and in Italy. The variety most esteemed in Paris is the Large Green, or Laon. It is used green as a salad when the heads are quite green; also boiled. The young shoots are also sometimes blanched and used as a salad. The plant is a perennial, and remains in good bearing condition four or five years. It is increased by offsets taken off in the spring, as it cannot be depended upon to come true from seed. It is also liable to be killed by severe frost, and would therefore not be likely to succeed in the northern portions of the United States.

Mushrooms. Mushrooms.

Mushrooms of very superior quality were also constantly on exhibition, not only from open-air culture, but from the subterranean caves or galleries which underlie and traverse the city of Paris and its environs for many miles in all directions. These galleries, of which the so-called Catacombs are a portion, have been formed in years past by quarrying Subterranean galleries.

Exhibitions of vegetables.

the stone of which the city is built. This stone, which lies beneath this whole region at 30′ to 60′ deep, is a soft, light-colored limestone, easily cut, but hardening by exposure to the air, and has been taken out and brought to the surface through large circular wells or shafts 8′ or 10′ in diameter.

Mushrooms.

At the bottom of these shafts are large chambers, from which radiate galleries in various directions, often communicating with other chambers and shafts at greater or less

Subterranean galleries.

distances, forming a labyrinthine network underneath the whole neighborhood. These galleries vary greatly in their dimensions from 5′ or 6′, to 20′ or more in width, and in height from 5′, to 15′ or 20′. The wider portions of the galleries and chambers are supported by stone pillars, and the passages protected on each side by stone walls, sometimes laid dry and sometimes in solid masonry laid in cement and arched overhead. It is in these underground galleries and chambers that the principal portion of the mushrooms used by the city of Paris are grown, and in

Entrance shafts.

most of them the only entrances are through the circular shafts above mentioned, and through which all the material for miles and miles in length of mushroom-beds have to be taken up and down on rude ladders, formed by single poles bored through at regular intervals and furnished with sticks for support in climbing or descent. In some cases, there are entrances to these galleries from excavated quarries, which are much more convenient and greatly diminish the labor.

Mode of growing.

The mushrooms are grown in long, parallel beds of partially decomposed stable-manure, about 20″ wide at the base and 18″ high, sloping at the sides and quite narrow at the top. These beds are quite close, allowing only a narrow path between, and a sloping bed is also formed on each side against the walls. All are covered with about 1″ only of light, sandy soil, formed principally from the *débris* of the quarries. And here, in these dark caverns, where no ray of light ever penetrates, except the feeble rays from the lamps of the workmen, the labor of mushroom-growing is going on, night and day, the year round. New beds are formed at intervals to keep up a constant succession, while the spent material of the old and exhausted beds has to be as often entirely removed. In one of these places which I visited there were beds in every state of development; some with little mushrooms just starting and barely visible, and from these through all gradations to beds thickly studded with large quantities, from 1″ to 2″ in diameter, and ready for gathering. In passing through these galleries we came to another shaft, with its pole-ladder reaching

down to a still lower depth, and were told there were other galleries and mushroom-beds at the bottom, cultivated by the same proprietor, who informed us that he used altogether about twelve miles in length of these underground galleries in growing mushrooms for the Paris market. I confess to receiving the statement of the "twelve miles" with a good deal of doubt, but some French people who were with me did not seem to regard it as an improbable story. I was informed there were 200 or more of these mushroom-growers in different sections, in the vicinity of Paris, and that some of their underground plantations yielded 1,000 lbs. per day, valued from 10 to 20 cents per pound, according to the quality and season. There were two varieties on the Exposition tables and also in the markets, differing but little apparently except in color. One kind was very white, the other a yellowish-gray color, and usually rather larger in size than the white variety.

Exhibitions of vegetables.

Mushrooms.

Mode of growing in subterranean galleries.

Market of the Halles Centrales.

Halles Centrales.

At the Halles Centrales, or large central market of Paris, in May, I found much the same varieties of vegetables and horticultural productions as were brought to the Exposition tables. In vegetables, May 20, there were asparagus (extra fine and large), cauliflowers, small early carrots, leeks, cos lettuce (very large and fine), endive, small new potatoes, onions, cucumbers, little green melons, peas, string-beans, mushrooms, tomatoes, small early radishes, early cabbages, etc. In fruits there were strawberries, apples, cherries, oranges, grapes, apricots, and green almonds. Cut-flowers were also in considerable quantity and variety. Large bouquets of rosebuds, violets, mignonette, sold for 2 fr. (40 cents); large strawberries, 25 cents per pound. September 20, I found some variations in the vegetable department. The principal offerings were small asparagus, fine cauliflowers, cabbages, chicory, celery, carrots, cucumbers, cresses, Brussels sprouts, globe artichokes in great quantity, beans (string and shelled), radishes, lettuce in variety, parsley, onions, leeks, potatoes, egg-plants, tomatoes, peppers, gherkins, Swiss chards, spinach, melons, squashes, and pumpkins—the latter usually cut and sold in slices at 10 centimes (2 cents) each. Apples, pears, peaches, plums, and grapes were the principal fruits. In flowers, asters, carnations, dahlias, forget-me-nots, gladiolus, heliotropes, mignonette, orange-blossoms, pyrethrums, roses and rosebuds, and stocks in variety.

Central market of Paris.

Vegetables on sale May 20.

Fruits and cut-flowers.

Price.

Market on September 20.

Vegetables.

Fruits.

Flowers.

Flower-markets of Paris.

Flower Markets.

The flower markets of Paris are also very interesting, being held every day of the week in some part of the city, except Sunday, upon which day dog markets and bird markets are held instead. There is a flower market on the Quai de la Cité, Rue Aubé, near the Palace of Justice, on Wednesdays and Saturdays; in the Place de la Madeleine, near the church, on Tuesdays and Fridays; and on the Boulevard St. Martin, near the Château d'Eau, and also in the Place St. Sulpice, near the church, on Mondays and Thursdays. The market in the Quai de la Cité, on the left bank of the Seine, near the Hôtel Dieu, is most conveniently arranged, and perhaps the most interesting of all Under the shade of rows of fine young Pawlonia trees are long, open, tent-like sheds, with iron supports and zinc or iron roofs, under which, on the market days, the finer flowers are displayed. In addition, all the adjoining space on the quai, in the streets, and on the neighboring bridge, Pont au Change, the more common flowers, as well as large quantities of ornamental trees and shrubs and trailing vines, with their roots in paniers or mats, are exposed for sale. About the middle of July, I found the following as the principal kinds of flowers and plants, but in great variety and quantities:

Varieties on sale, July 15.

Aloes.
Aloysias.
Alternantheras.
Amaranths.
Asters.
Balsams.
Begonias, in great variety, both broad and small leaved.
Cactus.
Cannas.
Carnations.
Chinese pinks.
Coleus.
Coxcombs.
Dahlias.
Echeverias.
Ferns.
Forget-me-nots.
Fuchsias.
Geraniums, in wonderful variety, of all colors, double and single, and of rose and other scented sorts.
Gladiolus.
Gomphrenas.
Heliotropes.
Hydrangeas.
India-rubber plants.
Japan lilies.
Marigolds.
Morning glories.
Oleanders.
Palms.
Pelargoniums.
Phlox.
Portulaccas.
Pyrethrums.
Roses, in every variety of form, kind, and color, and in the greatest quantities.
Snapdragons (*Antirrhinum*).
Tropæolums.
Veronicas.
Verbenas.
Vincas.

These flower markets seemed always well attended, and by all classes, young and old. In every direction flowers,

plants, and shrubs were borne away, the finer varieties by liveried servants from the carriages of the wealthy, and the more common flowers by the laboring classes—men, women, young girls, and often children among the purchasers. Large masses of cut flowers, both in single varieties and in large and tastefully arranged bouquets, were always present at these markets, where flowers of any kind could be had for ornamental, decorative, or other purposes.

Flower markets of Paris.

The French must be regarded as a flower-loving people, for not only do ornamental flower-beds appear everywhere in great profusion in their public gardens, parks, and squares, but about their public buildings, fountains, statues, and at street-crossings, wherever available space can be found. In private gardens, also, not only in the places of the wealthy, but around the dwellings of the humblest cottager, the flower-beds are almost always present. And also at the country and suburban railway stations, there are almost always handsomely kept flower-beds, and sometimes long ribbon-lines of gay flowers and bright-foliaged plants along the sides of the railway track for considerable distances near the towns.

Love of flowers among the French people.

In public places.

Private gardens.

Around country railway stations.

The prominent and distinguishing features in French horticulture seemed to be almost infinite painstaking and special care; and it really seemed as if every tree and shrub and plant in and about the city of Paris and in the Exposition grounds had some one whose duty it was to look after and care for its special wants and requirements. All were so nicely kept that a faded flower or decayed leaf was rarely seen. Even in the grounds appropriated to the animal shows, one of the first things was the formation of a green lawn, in which were large oval beds made gay and attractive with brilliant flowering plants; and around the inclosure, and the exhibitors' tents, sheds, and buildings were large plantations of ornamental plants and shrubbery.

Infinite painstaking and care of French gardeners.

Market Gardens.

Market gardens.

The market gardens about Paris are also remarkable for careful culture and wonderful productiveness. They are generally small, containing from one to three or four acres, and nearly all those near the city are surrounded by high stone walls, upon which are closely trained pears, peaches, and grapes. Numerous hot-bed frames, sometimes heated by hot-water pipes, and great numbers of *cloches* or large bell-glasses, are found in all these gardens for growing and protecting early vegetables and plants, and are in constant

Small walled gardens with *cloches* or frames for protection of plants.

Market gardens.

use from October to May. The sashes for many of the frames are of light cast iron, with handles at the end, making them

Bell-glasses.

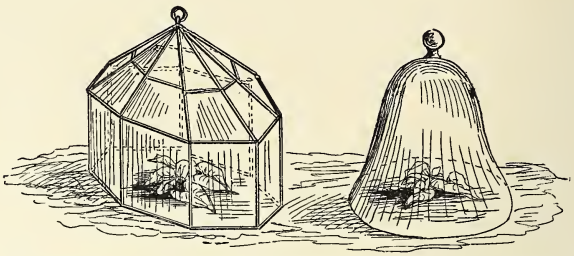


FIG. 36.—*Frame and bell-glass, or cloche, used by market-gardeners for salads and other young plants.*

very convenient and durable. The bell-glasses are very large, 16″ to 18″ in diameter, and are principally used for

Rack for bell-glasses.

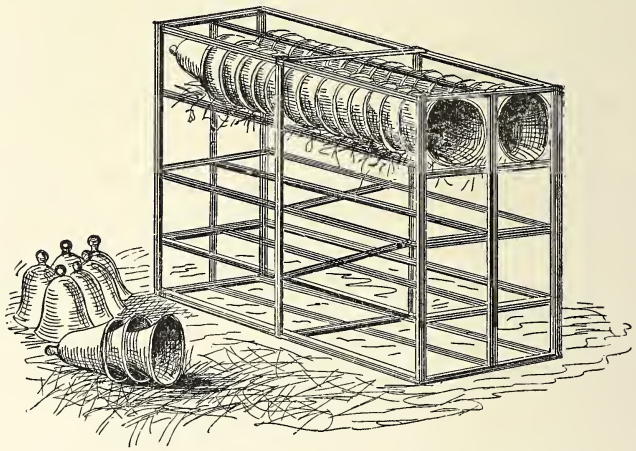


FIG. 37.—*Rack for storing or transporting the cloches.*

growing lettuce and other salad plants for winter and spring markets. They are also very useful for striking cuttings,

Osier and paper plant-protectors.

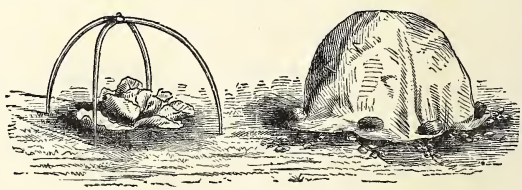


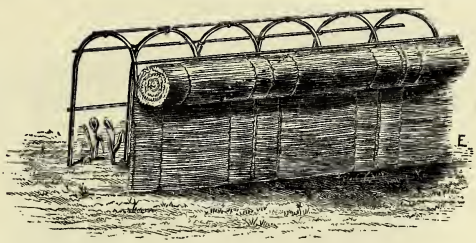
FIG. 38.—*Simple frame of osier willow, covered with oiled paper or muslin, to protect from frost.*

and for growing seedling plants in early spring. It seems surprising that the gardeners can be successful, for near the

city, in addition to the high cost of manure and other fertilizers, they are obliged to pay a rent of $100 to $125 per acre

Market gardens.

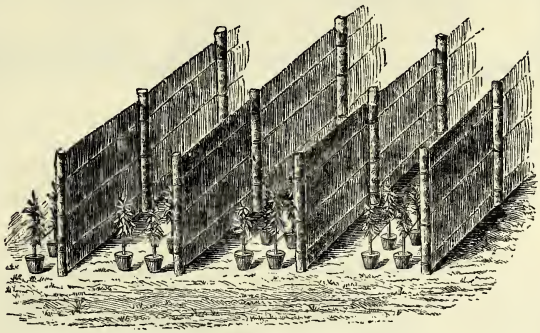
High rent and costly manure.



Straw-matting plant-protectors.

FIG. 39.—*Frame, with plants protected by straw-matting.*

per annum. But they cultivate every inch of the ground, and often have two or three crops planted on the same area,

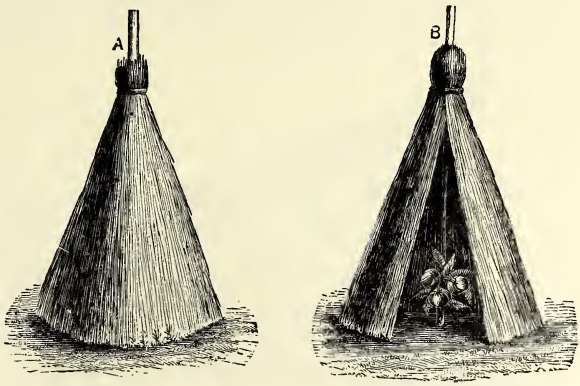


Straw-matting sun screens.

FIG. 40.—*Protection of plants from the sun in summer by screens or "pail-lassons" of straw-matting.*

which are taken off in succession. They manure highly, plant closely, cultivate perfectly, water abundantly, and

Careful cultivation.



Tomato tents.

FIG. 41.—*Protection of rye-straw for tomatoes.* A, *closed for the night;* B, *open by day.*

keep the ground constantly occupied both winter and summer. I was told they managed to take as many as eight

Market gardens. Successive crops from the same ground.

successive crops in a season, with various kinds of salads, radishes, potatoes, cauliflowers, cabbages, etc.

Permanent hot-beds.

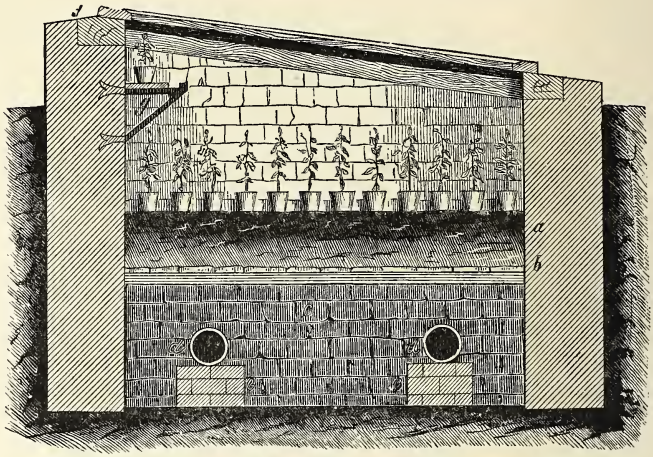


FIG. 42.—*Permanent hot-bed, heated by hot-water pipes.*

The illustrations (Figs. 36–48) are from the "*Bon Jardinier*," and are a few of the appliances used by the French

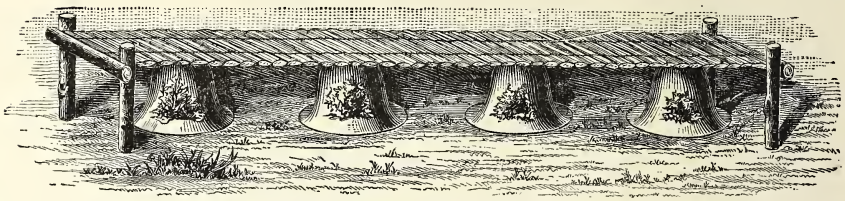


FIG. 43.—*Cloches protected by paillassons or straw-matting overhead.*

gardeners in their operations. Their uses will be apparent without further description, and will serve to show the care-

Cloches with matting protection.

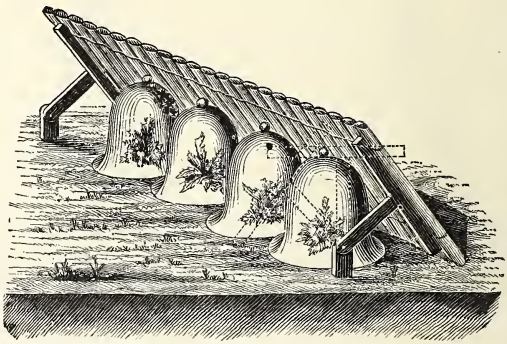
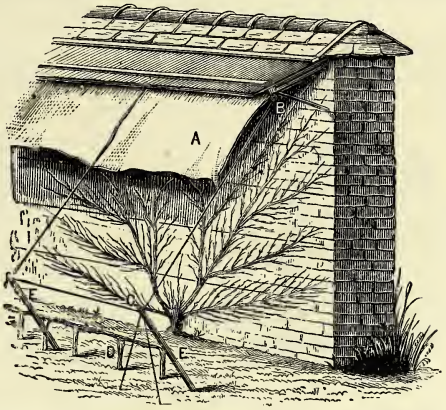


FIG. 44.—*Adjustable protection of straw-matting for cloches.*

ful attention given to growing plants, and the methods of protection employed to insure success.

Figs. 49 and 50 represent a very ingenious and useful implement, having important advantages over the perforated

Market gardens.



Matting protection for espaliers.

FIG. 45.—*Espalier trained on wall, protected by straw-matting and shaded with cotton or linen cloth.*

sprinkler. By changing the shape of the lip (Fig. 50), or having tips of different sizes, and increasing or diminish-

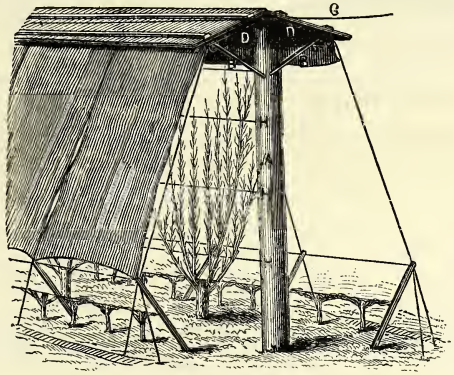


FIG. 46.—*Double espalier with vertical cordons, protected by straw-matting and muslin or linen cloth.*

ing the aperture, these water-cans may be adapted to all kinds of work in sprinkling for the garden or greenhouse.

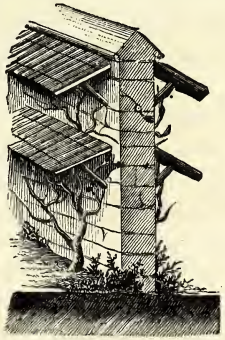


FIG. 47.—*Shelter for espaliers on wall by straw-matting.*

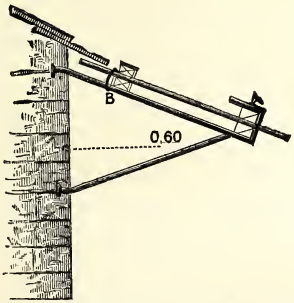


FIG. 48.—*Supports of iron for shelter of fruit on walls.*

Espalier shelters.

The work is done more rapidly, and the stream of water is spread into a wide, thin sheet, falling in fine spray and always uniform, and never clogging by slight impurities in the water, as with the perforated sprinklers. It is the invention of M. Raveneau, of Paris, and is largely used by the gardeners of Paris and vicinity, and much approved.

Watering can of Raveneau.

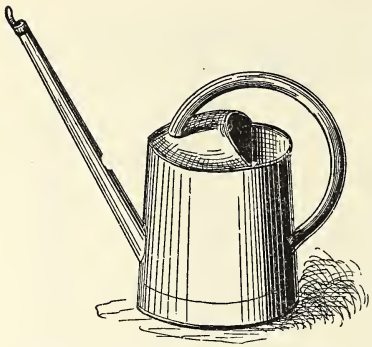


FIG. 49.—*Watering can of M. Raveneau.*

Among many appliances for sprinkling by hydrant pressure, that shown in Fig. 51 was novel and attractive. Owing to the shape of the revolving pipe, which was rapidly moved by the flow and discharge of the water through the nozzle, the whole machine could be made to move in a circle, forming a radius the length of the connecting pipe or hose, or to move forward, by short steps or jerks on its three legs, to the length of whatever hose might be attached.

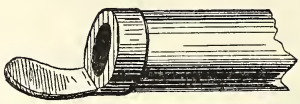


FIG. 50.—*Nozzle of French water-can, with copper lip, for sprinkling flowers and plants.*

Revolving lawn sprinkler.

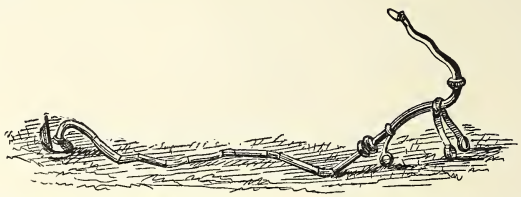


FIG. 51.—*Revolving lawn-sprinkler, self-acting. Exhibited by M. Raveneau.*

Lawn-mowers.

Lawn-mowers.

Of several patterns of lawn-mowers used on the Exposition grounds, the most effective and favorite machines appeared to be those of the style of the Philadelphia lawn-mower, or some modification of it; and in the later days of the Exposition I saw no other kind in use on the lawns.

American type.

Horticultural tools. Borel.

The illustrations of tools used in French horticulture, shown in Fig. 52, are from the card of M. Borel, one of the exhibitors, and give fair representations of a portion of his exhibition. The gardening implements are all heavier than those of American manufacture, and appear clumsy and inferior by comparison. American gardening tools have been introduced to some extent about Paris, and I was in-

formed were preferred to those of French manufacture on account of their lightness, better shape and adaptability, better temper, and superior finish. Horticultural tools.

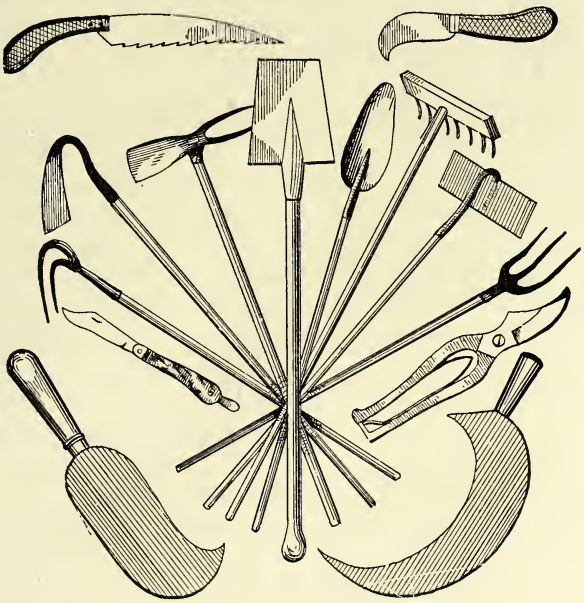


FIG. 52.—*Group of horticultural tools in Exposition.*

Street and shade trees. Street and shade trees.

The planting and culture of shade and ornamental trees in the avenues, squares, public gardens, and boulevards, and along the quays upon the banks of the Seine receive special attention, and add greatly to the beauty and attractiveness of the city and its surroundings. The older plantations of trees in the Garden of the Tuilleries, the Garden of the Luxembourg, the Garden of Plants, the Champs Élysées, and many other places, seem to have been mostly of elms, plane-trees, lindens, and maples; but the later plantings, particularly upon the avenues and recently-opened boulevards, are nearly all of horse-chestnuts; the plane-tree, or Western sycamore, being the favorite tree for the river banks, and the pawlonia in many places in the public squares and gardens. Elms, planes, lindens, and maples. Plane-trees and

The horse-chestnuts are very beautiful in spring and early summer, shading the walks in double rows upon the wider boulevards, and their straight, smooth trunks and symmetrical heads, with spikes of abundant white and pink bloom amid the fresh, green foliage in the month of May, are very charming. horse-chestnuts now preferred.

Street and shade trees.

The larger-growing evergreens are sparingly used, except in the large gardens, where there are some fine specimens,

Sequoia and Deodar cedar.

among which the *Sequoia gigantea* and the Deodar cedar were specially fine and luxuriant. The smaller ornamental evergreen shrubs are, however, abundant, and in connection with those of deciduous habit are used in the greatest profusion.

Climbers and vines.

Beautiful effects were produced in the parks and gardens by training upon the trunks of the large trees trailing vines of different varieties of clematis, honeysuckles, ampelopsis, and ivy. The beauty and luxuriant growth of the ivy in and about the city of Paris is something wonderful. It is used everywhere—in mixed borders and gardens; for shading bowers and porches; training about artificial rock-work

The ivy.

and fountains; for covering walls, iron railings, and trellises; forming dense screens in many places, fresh and green, but as impervious to sight as stone walls. It is also effectively used in pots and boxes for interior decoration, trained about pillars and about windows, and wherever its graceful, trailing habit and charming freshness is desirable.

Municipal care of the public trees.

The watchful care extended by the city government over the trees within its limits is quite remarkable. Each individual tree seems to be looked after and all its special needs supplied. If exposed to outside contact, it is protected by a circular shield of iron rods, studded with sharp points.

Straightening and pruning.

If a young tree is disposed to grow crookedly, it is bound to a straight and slender pole, running its whole length, until its upright growth is established. Every limb or branch that grows irregularly is pruned to shape. And although this pruning is sometimes carried to excess, producing the topiary monstrosities at Versailles and other places, by shearing evergreens and other trees into distorted and unnatural shapes, in other cases it is only used to direct the growth of trees to the most perfect development in their characteristic forms, and must then be most highly commended.

Grating in pavement.

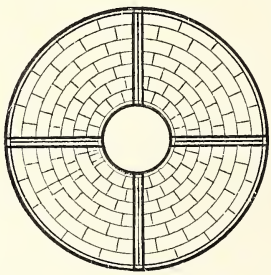


FIG. 53.—*Open-work iron grating, in four sections, around trees in asphalt pavement in Paris.*

In the asphalt pavements along the boulevards, where thousands of trees are planted, each tree is surrounded at its base by a circular iron grating, 6′ or more in diameter, to afford access to the roots by the air and the rain, or for artificial watering if required. These gratings (Fig. 53) are of ornamental iron-work, cast in four

sections, with an inner circle large enough to accommodate the trunk of the tree when it attains a growth of a foot or more in diameter; and, being in sections, are easily removable when it may be desired. Wherever building was going on, or any repairs, whereby the safety of the trees upon the streets would be endangered, circular stone walls, 18″ high, were solidly built in cement on the outer circle of the iron gratings encircling all the trees in the vicinity (Fig. 54).

Street and shade trees.

Temporary wall protection.

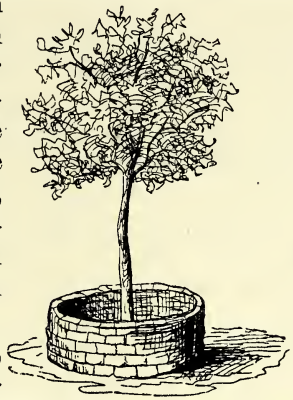


Fig. 54.—*Stone wall around young tree in pavement for temporary protection.*

The immense quantities of trees, shrubs, and flowering plants required for the ornamentation of the city are produced in extensive propagating houses, gardens, and nurseries under the care and direction of the government. In these establishments are produced the trees and plants in almost endless variety for the boulevards, parks, squares, and gardens.

Propagating nurseries.

The *Jardin Fleuriste* is a very large establishment, where the principal portion of the flowering plants for the use of the city are produced, situated at the end of the Avenue d'Eylau, and quite near the Port de la Muette, leading to the great promenade of the Bois de Boulogne. It is furnished with numerous and expensive glass structures and all the appliances for the most extensive production and care of plants of all kinds used for decorative purposes.

Jardin Fleuriste.

The principal nursery for trees for street planting is near Nogent-sur Marne, where something like 50 acres are devoted to this purpose alone. There are other nurseries where hardy shrubs and flowers are produced in immense quantities for public use, the most extensive of which are in the Bois de Boulogne and the Bois de Vincennes.

Nursery of Nogent-sur-Marne.

The Champs Élysées, the great central public garden and avenue of the city of Paris, is also a principal promenade and drive in connection with the Avenue du Bois de Boulogne, which leads from the termination of the avenue of the Champs Élysées at the Arc de Triomphe to the celebrated Bois de Boulogne, the most charming of all the parks and gardens in the neighborhood of the city, and most frequented by its inhabitants.

Champs Élysées.

Bois de Boulogne.

The garden of the Champs Élysées, which extends from the Place de la Concorde to the Rond Point, near the Ave-

Garden of the Champs Élysées.

nue d'Antin and Avenue Matignon, a distance of over 2,000 feet, with an average width of about 1,200 feet, contains much that is interesting in the way of fountains, ornamental flower-beds, handsome shrubs, smooth grass plats, and fine trees, both deciduous and evergreen. In addition to fine specimens of magnolias, conifers, and other trees, there are masses, belts, and clumps of rhododendrons, hollies, azaleas, euonymus, and other choice shrubs in great profusion, and all kept in the highest state of cultivation.

Avenue of the Bois de Boulogne.

The Avenue du Bois de Boulogne, before mentioned, is also one of the largest and most remarkable, as well as one of the most beautiful, about the city. It is about three-fourths of a mile long and near 400 feet in width, containing a wide, central road, with charming grass plats and ornamental beds, gay with shrubs, flowers, and pleasant walks on either side for the whole distance. The Bois de Boulogne

The Bois.

contains 2,250 acres, and is beautifully diversified with charming woods, lakes, cascades, rustic bridges, and every variety of artistic, ornamental planting of trees, shrubs, and flowers. It is also traversed in all directions by well-kept drives and walks, which are, in pleasant weather, constantly occupied by the pleasure-loving inhabitants, both in carriages and on foot.

The elms and most of the forest trees in the Bois de Boulogne, and especially those in the Garden of the Tuilleries, which were fresh and beautiful in the spring and early summer, turned brown and lost much of their foliage in August. In many parts of the city this was quite noticeable, not only with the elms, but to some extent with the horse-chestnuts also. The plane-trees, which seemed the same as our American sycamore, and the pawlonias retained their freshness and foliage much better.

Exhibition at Versailles,

Exhibition at Versailles.

In addition to the horticultural exhibitions upon the Exposition grounds, a large exhibition of an international char-

of flowers, plants, trees, and vegetables.

acter was made at Versailles about the middle of August, to which the English gardeners about London contributed largely, bringing many choice specimens of rare plants from their greenhouses, which, with the large collection of the more common and hardy plants, and a large display of seasonable fruits, trees, and vegetables, made an attractive and interesting show. Among the more common flowers were very fine collections of—

Asters, in great variety of style and color, very full and large and well grown.

Exhibition at Versailles.

Begonias, in great variety, both large and small leaved, including a remarkable collection of double-flowering kinds, some resembling the double-flowered pomegranate.

Caladiums of various sorts, very ornamental in foliage.

Flowers.

Coleus, many kinds in great variety, some very rich in color and variegation.

Dahlias, in large quantity and great variety of size and color.

Fuchsias, in charming variety, some trained in tree form 10′ high.

Gladiolus, geraniums, and gloxinias, in great quantities and almost endless variety.

Heliotropes, fine specimens, 6′ to 8′ high.

Petunias, some very fine variegated double and single varieties, quite attractive.

Verbenas and zinnias and other bedding plants were also shown in great perfection.

Ferns.

Some remarkably fine specimens of ferns were shown. Among the adiantums, Farleyense was quite conspicuous; also some fine aspidiums, davallias, gymnogrammas of variegated sorts, nepholepis, etc., very beautiful.

Hot-house plants.

In stove or hot-house plants, orchids, palms, etc., the show was very fine, but space will not permit special mention, except of a few of the most remarkable specimens, among which were finely grown—

Anthuriums.
Aralias.
Alsophyllas.
Crotons.
Dracænas.
Cyanophyllums.
Cissus discolor.
Cyrtodiera fulgida.
Dendrobiums, very fine.
Bertolonia Van Houtteii.
Philodendrons.
Pritchardias, etc.

Wills' collection.

Mr. Wills, of London, had a very fine collection of rare plants, handsome and well grown, among which were very fine specimens of—

Agaves.
Anthuriums.
Aralia filicifolia.
Artocarpus Cannonii (bread-fruit tree, with handsome dark-red leaves).
Cocos Weddelliana (beautiful feathery palm).
Crotons in splendid variety, including Bentonii, Falcatus, Johannis, Prince of Wales, Queen Victoria, Sunset, Volutum, and others.
Curculigo recurvata variegata.
Diplandenia amabilis (fine greenhouse climber).
Nepenthes hybrida, Phyllamphora, Rafflesiana, and others.
Phœnix and Pritchardia grandis (fine palms).
Sarracenia Drummondii and Darlingtonia.
Theophrastus imperialis.

Also a splendid collection of—

Orchids.
Cattleyas.
Cypripediums.
Dendrobiums.
Nidulariums.
Odontoglossums.
Oncidiums.
Saccolabiums.
Tillandsias.

Also, a fine collection of rare ferns.

Exhibition at Versailles.

In this exhibition of Mr. Wills was a remarkable collection of dracænas, of which—

Wills' collection.

Alba marginata,
Berkleyii,
Bunseii,
Fredericii,
Gladstonii,
Ignea,
Leopoldii,
Majestica,
Regalis, and
Willsii.

were new and specially fine.

Also odontoglossums—Alexandre, Eldorado, Loddigesii, and Disa grandiflora.

Also a large oval bed of gloxinias in great variety.

James Veitch & Sons.

James Veitch & Sons, of London, also exhibited remarkably fine specimens of the following—

Anthuriums.—Brownii, Thibautiana, Veitchii, and Warocquianum.
Alocasia Thibautiana.
Cattleyas.—Dominii, Gigas, Hybrida picta, Normanii, and Veitchii.
Crinum Vershaffeltianum.
Cypripediums.—Ashburtoniæ, Calanthum, Euryandrum, Sedenii, and Stelligerum.
Dendrobium formosum.
Epidendrums.—Viticella and Viticella major.
Nepenthes.—Ampullaria, Courtii, Hybrida maculata, Kennedyana, Rubra hybrida, Sanguinea, Sedenii, Stewartii, and Zelonica.
Odontoglossums.—Alexandræ, Rossi majus, and tripudians.
Oncidums.—Concolor, Incurvum, Lapigeria alba, Prætextum, and Stelligerum.
Phalænopsis grandiflora.

The floral exhibition was made in a large circular pavilion and was very tastefully arranged. The above are only a few of the more striking of the great variety of rare plants exhibited.

Fruits and vegetables.

There was also an exhibition of fruits and vegetables at the same time, principally from France and Italy. In the French section there were—

200 plates of grapes, including some new seedlings.

About 400 plates of pears, generally well grown.

About 100 plates of apples, from medium to poor.

A few specimens of very fine peaches.

250 plates of potatoes, mostly of English and French varieties, small and inferior in appearance. A few American sorts, among which Early Rose, Eureka, and Peerless appeared the best.

From Italy 20 plates of grapes, generally very large and handsome. Among them some very fine clusters of varieties named Bianca di Chieri, Fiesolano, Pribiano, and Virginia, all white, were remarkable for size and beauty.

25 varieties of handsome apples, large and well grown, from Turin.

There were also from Italy a few fine specimens of plums; also oranges, lemons, almonds, filberts, and walnuts. Exhibition at Versailles.

Fruit trees in great quantity were also exhibited in the grounds, in various styles of espalier and *quenouille*, and other shapes of pruning and training, both high and low, which were both novel and interesting. Trained fruit trees.

A fine collection of rare evergreens, large and small; many with variegated foliage; a very handsome display of Auracarias. In shrubs and small trees there were also exhibited, in great variety, aucuba, arbutus, bambusa, buxus, coto-neaster, daphne, eleagnus, euonymus, ilex, ligustrum, laurus, laurocerasus, oleanders, osmanthus, phillyrea, photinia, pomegranates, rosmarinus, viburnum, etc. Evergreens and shrubs.

A somewhat novel screen or trellis for growing and protecting grapes was exhibited here, (Fig. 55), too expensive for practical use in the United States, but interesting as illustrative of the extraordinary care given to the production of fruits by the French gardeners—a row of posts planted quite near, with grooves sawed at the sides opposite each other to receive glass plates, also a light frame above, with glass for the protection of the vines below. Vines were planted on each side of the glass. Another similar affair was exhibited with thin sheets of black slate, for the radiation of additional heat, and to hasten the maturity of grapes, planted only on the side facing the sun. Grape trellis.

FIG. 55.—*Light trellis with plates of glass, exhibited at Versailles.*

GRAPE CULTURE.

Grape culture.

In the neighborhood of Paris, the larger portion of the grapes are grown for table use, and are either grown under glass or upon walls. A few varieties are grown in open vineyard culture—early ripening kinds, white and black, and of small size, not larger in bunch and berry, under ordinary culture, than the Delaware or Clinton. But grape-growing in the neighborhood of Paris did not impress me as being less difficult than at home, and, except that their winters are less severe, I do not think they have equal advantages for success with the grape-growers in the State of Ohio. With the same care and cultivation, I believe we could grow even the same varieties with equal success. A very large collection of grapes from all quarters of the globe Near Paris, upon walls or under glass.

Grape culture.

was growing in a trial vineyard at the Garden of Acclimation. A more utter failure I never saw, in the worst season, in the United States. The grapes were mildewed, cracked, and rotted. A perfect bunch could not be found. One of the gardeners told me it was caused by neglect to use sulphur at the proper time, and that he thought it might have been prevented.

Failure of the grapes in the Garden of Acclimation.

The unusually wet season.

I afterward saw in private gardens many grapes in the same condition. The season was unusually wet, and this measurably accounts for the failure; for scarcely a day passed during the summer without rain, and there were a few days of extreme heat also. Upon the walls, where the grapes were protected, and also sheltered by a projecting ledge or coping overhead, they seemed generally healthy, wherever they were well cared for. And in France "care" means a careful training of the vine upon the wall, so that the shoots are not crowded; thinning out of the bunches, that the vines shall not overbear; and also a careful thinning of the berries from the clusters to prevent crowding and cracking. Sulphur is also used freely to prevent mildew. The *Phylloxera* is said not to have been observed within a hundred miles or so of Paris.

Advantages of the protection of walls and coping.

Use of sulphur.

The district of Thomery, near Fontainebleau.

The most celebrated vine-growing district in the vicinity of Paris is the celebrated Thomery, near Fontainebleau, and there the Chasselas Fontainebleau grapes are grown in great perfection. They are grown either upon high, whitewashed

Wall and coping at Thomery.

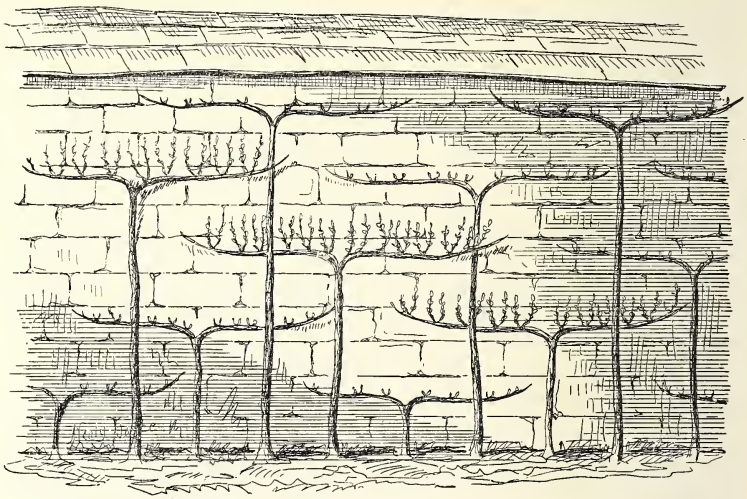
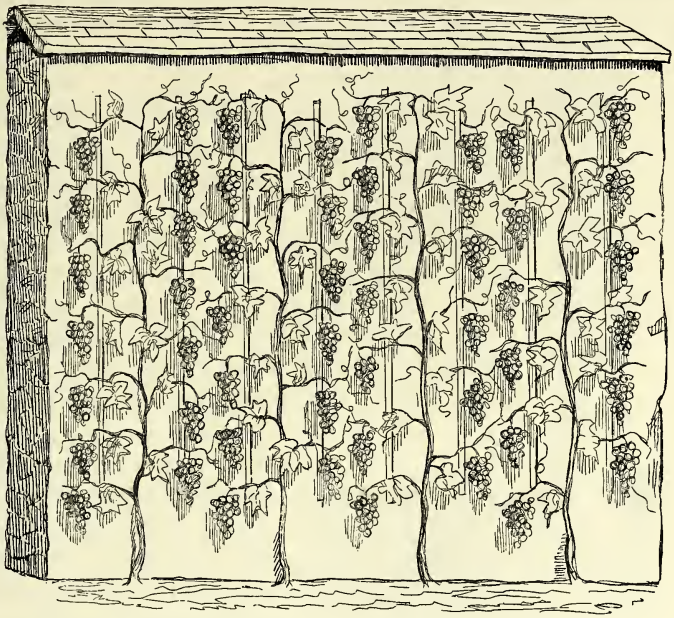


FIG. 56.—*Grape vines as trained at Thomery on walls, with projecting coping above; part of the vines pruned.*

walls with projecting copings above, or on lower trellises, where they receive protection from the walls, which are the

main feature in the vineyards at Thomery, running in all directions, and usually from 8′ to 10′ high (Figs. 56–58). Grape culture.



Wall-training at Thomery.

FIG. 57.—*Vines trained on walls; pruned on the "spur-system."*

The trellises between the walls are also provided with means for protection overhead, either by boards or a kind of bituminized cloth. These projections and coverings appeared to be movable, and could be used or not as occasion required.

At the School of Horticulture at Versailles, which is under the direction of the French Government, there are also large gardens under the same charge, which formerly belonged to the Palace of Versailles. Here also were high walls in every direction, all utilized by closely trained grape vines and a few peach and pear trees. The grape walls were about 10′ high, a movable step or platform on wheels being used for attending the upper portion of the vines. The impression made upon me was that if half the care and attention were bestowed upon grape-growing in this country, there would rarely be a complaint of failure with our hardy varieties. I afterward visited one of the most celebrated wine-producing districts in Southern France, in the neighborhood of Montpellier, a region where grapes and wine are the principal product, but which is threatened with entire destruction by the persistent and aggressive attacks of the *Phylloxera vastatrix*.

School of Horticulture at Versailles.

Wall culture.

The phylloxera at Montpellier.

The modes of culture were there entirely different from those about the city of Paris, corresponding to a different

Grape culture.

climate. With very little rainfall and a mild and equable temperature, vines were planted without stakes, trellis, or support of any kind; and were never allowed to grow more than 3′ or 4′ high—a large stub or stump at the base, usually from 1′ to 18″ high, and with two to four short, stubby arms, from the ends of which the fruit-bearing shoots are grown, the fruit hanging in clusters about the stump and near the ground. These shoots appear to have been kept pinched or shortened during the growing season, and in the spring or fall pruned back within a few eyes of the self-supporting stump. No tying or special training appeared in any case. These vineyards were in every intermediate condition, from moderate fruitfulness to absolute destruction; and on all sides were abandoned vineyards grown up in weeds, the dead and blackened stumps marking the path of the destroyer. Sandy soils appeared to resist attack longer than retentive clay, but it was said to be only a question of a little longer time when these too would succumb. I saw many vineyards where the vines were being taken out; some were grubbed up with mattocks, others drawn out with a kind of miniature stump-puller with a windlass and hook.

Vineyard culture.

The destruction of vineyards in the south of France.

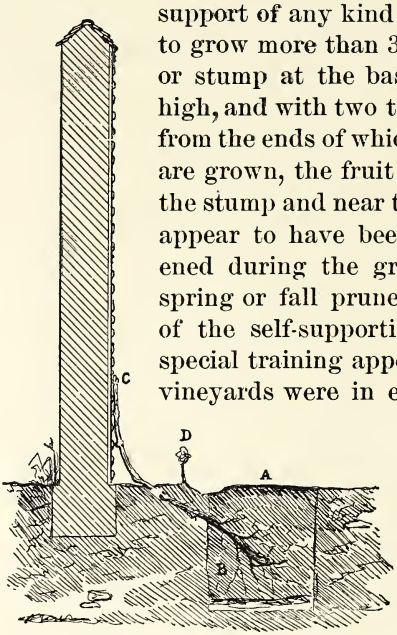


FIG. 58.—*Mode of planting vines upon walls "in espalier."* A, *trench 3′ from wall filled with new fresh soil for receiving the young plants;* B, *roots of young vines;* C, *cane of vine pruned and trained upon wall.*

Congress of grape-growers at Montpellier.

At the city of Montpellier there was held a congress of grape-growers, to which there were delegates from Bordeaux, Marseilles, Toulon, and all the wine-growing sections of the south of France bordering on the Mediterranean. There were also delegates from Italy, Spain, Hungary, and Austria, and perhaps other countries also. The object of the meeting was announced to be the investigation and study of the "American vines," and I could not help noticing in the large assemblage the deep interest felt in the subject, and the favor with which the confident state-

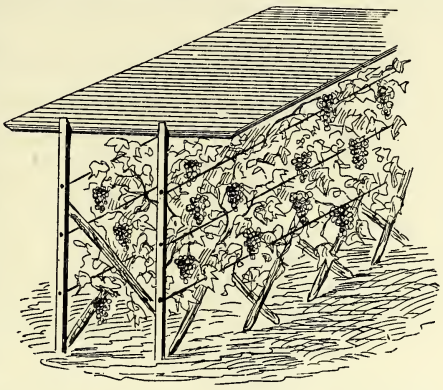
Delegates from various countries.

FIG. 59.—*Vine pruned and trained upon stake-vineyard. a, stake; b, b, b, b, fruit spurs cut back to two or three eyes.*

ments were received that these American vines afforded a solution of the *Phylloxera* question, and a remedy for the evil that threatened the ruin of their grape and wine interest. While they appeared to me in a strait little short of desperate, and ready to catch at any proposed remedy that promised success, the testimony certainly seemed to warrant ground for their hopes, as narrated by those who had longest and most perfectly experimented, both by grafting the French vines upon American varieties and by growing the American vines on their own roots.

Grape culture.

The phylloxera.



Hopes of success in American stocks.

FIG. 60.—*Grape vines protected by shading overhead on double espalier.*

That the present condition of these vines is wholly owing to the injury by the *Phylloxera* I cannot quite believe, although it is evidently the last or present and palpable cause of their death. Their habitual treatment and, to some extent, want of culture has, I believe, weakened the vines in all their older vineyards, and prepared them for the attacks and inability to resist the effects of the *Phylloxera*. A grape vine whose natural habit is to climb and make long, twining shoots is planted in soil not too good at first, crowded into a circumscribed space with hundreds of its fellows, 3′ or 4′ apart. Then, instead of allowing a natural development, it is cut down within a foot of the ground, and the main stem never allowed to grow any higher. No support is furnished for the slender shoots, and the grapes are grown around the top of this little stub for year after year. A vineyard of this kind looks at a little distance like a field of closely planted currant bushes. I am satisfied, from various experiments I have made, that this excessive cramping and pruning of the vine has a tendency not only to weaken the growth, but to destroy the roots; and that this essentially vicious treatment has so weakened their constitution that they fall an easy prey to the invading insect destroyers. One of the delegates from Spain took the ground that the *Phylloxera* was the effect of weakness in the French vines, and not the cause of their destruction. While his arguments were probably incorrect, there certainly appears some ground for his opinion.

The probable cause of the devastation, the weakening of the stock by the artificial conditions of the culture and treatment.

Grape culture.

The interest of the discussion was fully kept up for three days, the conclusion being an enthusiastic indorsement of the use of American vines, and a settled belief in their success in enabling their own vines to resist the *Phylloxera* when grafted upon American roots. They say, however, if this grafting process fails, they will then introduce the American vines themselves, and make their red wines from them. I noticed, after leaving Montpellier, going eastward along the borders of the Mediterranean, vineyards in every imaginable state of dilapidation; in some cases nothing but rows of black or brown stumps, entirely dead, and others partially killed, with occasionally a weakly and yellow-looking individual in the last stages of dissolution. A few new plantations, evidently of American varieties, were looking bright and flourishing.

The phylloxera.

Adoption of the proposal to graft the French vines on American roots;

or, as a *dernier ressort*, the adoption of the American vines.

The greater hardiness of the American vine.

The greater hardiness of the American vines may enable them longer to resist; but if this same mutilating and dwarfing practice is pursued, although the evil day may be put off somewhat longer, I believe it will as surely come when their weakened condition will enable the *Phylloxera* to overcome and destroy them also. These people have cultivated the vine so long, and the business has been handed down from father to son in such unbroken succession, they feel incapable of substituting other agricultural products for their favorite grapes and wine. The appearance of the country indicates great former prosperity; the houses nearly all of stone; stone walls around their dwellings and gardens; for stone is plenty and labor is cheap. They have quite a diversity of soils—some brown, rich loam; gravelly clay, reddish clay, and in many cases underlaid by a natural drain of gravelly drift. The average soil would be called good anywhere, and the climate dry and equable, rendering it specially adapted to grape culture. Trials of growing wheat, they say, are unsuccessful, and some of them also say if their grapes fail them, they will have to expatriate.

The difficulty of substituting any other culture for that of the grape.

Evidences of former prosperity.

The soil and climate.

Disbelief in the efficacy of chemical remedies.

There is a general disbelief in the practicability of the chemical remedies proposed, both on account of inefficiency and great expense.

As far east as Marseilles, and for some distance beyond, the vines were still looking weak and badly. On the rocky hillsides, planted on terraces, occasionally they presented a better appearance, but were either in sandy soil or permitted to grow more luxuriantly. Vines allowed to grow on walls or trained in long shoots seemed always better.

Effect of less vigorous pruning.

Practical vineyardists regard the introduction of American vines as the only expedient which promises relief in

their present exigency, for they have found some kinds which appear not only to grow and flourish and bear large and healthy crops, in spite of the *Phylloxera*, but to give renewed health and vigor to their own native varieties when grafted on roots and stocks of American vines. Grape culture. The phylloxera.

I visited many gardens, vineyards, and nurseries where these various experiments are being made, and it seems, both from my own observation and the testimony of others, that several kinds of our American vines, especially those of southern origin, such as Herbemont, Lenoir, Pauline, and the Jacquez, especially, will succeed admirably in this region. The Jacquez is thought to be the same variety which was sent to Nicholas Longworth years ago in a cigar-box, and which was for a while cultivated and known as the "Ohio" or "Cigar-box" grape. Although it never acquired much popularity in the United States, and is now scarcely to be found in the Eastern, Middle, or even Southern States, it seems to be the grape of all others most valuable and best suited to the emergency now existing in France. The foliage is dark green, rich, and luxuriant, and the fruit without a blemish. Native vines grafted on this American vine were vigorous and healthy, while other French vines growing on their own roots beside these grafted vines were dying or already dead. In one place, though, I saw a case where an experimentalist had grafted the Jacquez upon the French stocks, and the Jacquez was also in this situation equally vigorous with its companions upon their own roots. The conclusion from this fact, if it be one, might render the question of the effects of the root upon the graft a little doubtful. Experiments with American stocks and vines. The American vines most successful in France. The "Jacquez" the most promising.

But the current is all one way, and the enthusiasm in favor of the American vines reminds me of the flush times in America when the "grape fever" was at its height, and grape-growing was the all-absorbing question in so many parts of the country. At the experimental garden of the School of Agriculture at Montpellier, they have a large and interesting collection of vines from various countries, but more from America than anywhere else. All our older and well-known varieties, many of Rogers's and Underhill's and Arnold's hybrids, besides the different types of our wild native kinds—the Riparia, Cordifolia, Labrusca, and Æstivalis—were all here represented. The Concord, Hartford, Rentz, Franklin, and grapes of that class, did not seem to be flourishing as well as those of the Southern type; partly, I have no doubt, because not as well adapted to this peculiar locality, but also on account of the extreme drought which was Experimental garden at Montpellier. American varieties. American types. Our Southern varieties most successful.

Grape culture.

then prevailing. But I could not help being impressed with the general health and vigor of the American vines, both where planted in large numbers and also in single specimen plants. The Clinton has been quite extensively planted in the way of experimenting, but does not appear in all cases healthy, the foliage suffering from a kind of black mildew which I have often seen at home.

The phylloxera.

The French distaste for our wines.

As a rule, the French people do not like the flavor of our wines, though they admit some of them to be good, and there are many who consider our vines only valuable as *Phylloxera*-resisting stocks for grafting. Others are willing to make an exception in favor of such varieties as the Jacquez and Norton's Virginia, Herbemont and Cynthiana, as a kind of *dernier ressort* in case the grafting process should finally prove unsuccessful, and as substitutes for the grapes from which are made the cheap and popular red wines, to which their people have become accustomed, and which they regard as one of the prime necessaries of life. The common laboring classes consume large quantities of these cheap, non-intoxicating wines, and I saw far less drunkenness in France than in those countries where whisky and ardent spirits are used by the people.

Preferences expressed for certain varieties.

Cheap red wine a French necessity.

Italian grape culture.

Italy, however, seemed to be a kind of paradise for the lazy grape-grower.

There the vines come nearer to growing and taking care of themselves than in any other country. While there were very few vineyards—that is, where the whole ground was occupied by vines—there were nevertheless grapes everywhere bordering the fields and roadsides and running in rows through the fields, leaving spaces from 100′ to 200′ between the rows of vines, where farm crops were cultivated. All these vines were grown upon trees, which appear to have been planted for their support.

Mode of growing and training.

A vine is usually planted on each side of the tree, running up and occupying the whole head of the tree, and then long shoots are trained laterally to the next tree, 10′ or 15′ away, the grapes and vines hanging in festoons along the lines in the most graceful manner. Dwarfish trees, headed rather low, were mostly used, and of various kinds. Occasionally fruit trees were used, but they seemed to prefer elm, maple, thorn, or mulberry; and when the distance between the trees was considerable, intermediate stakes were placed to support the vines, which were trained from tree to tree.

Not only in Italy, but in Switzerland, about Geneva and Lausanne, and in all places where the vines were allowed

to grow and spread themselves in accordance with their natural habits, they appeared vigorous and healthy, bearing abundantly, without any visible indications of failure. And although the delegates to the meeting at Montpellier reported the *Phylloxera* as having been found in Italy, Spain, Germany, and in Hungary, there was no report of such devastation as appeared in Southern France, where the close planting and short-stub system prevailed. I made some inquiry about the *Oidium*, which a few years ago was regarded as the great obstacle to successful grape-growing in Europe, but the reply was that it was so easily controlled by the use of sulphur that it was regarded as of no moment in comparison with the great and overwhelming danger from the *Phylloxera*.

Grape culture.

The phylloxera less troublesome with vines trained as in Italy.

Oidium.

UTILIZATION OF SEWAGE.

Sewage utilization.

Some interesting and valuable experiments have been made in the neighborhood of Paris in the use of the sewage from the city,* both from sanitary and economic considerations. The total length of the principal sewers of Paris is about 500 miles; two of the largest run at right angles with the river Seine, under the Boulevards St. Michel and Sebastopol, and receive several tributaries. Four others, running parallel with the river, two on the right and two on the left bank, traverse different portions of the city, following the directions of the principal quays and boulevards. These large sewers are from 4′ by 7′ to 16′ by 18′ in diameter, and are built of solid masonry laid in cement. They are called "*égouts collecteurs*," into which the smaller drains and tributaries are discharged, and then in turn are all discharged into a "collector general" in the Place de la Concorde. Those from the left bank are carried under the river Seine in an immense iron pipe, and into the "collector general," which latter is carried about 3½ miles to Asnières, outside the city walls, in a northwesterly direction, and where it formerly discharged its whole contents into the river.

The Paris sewers.

Length.

Size.

Crossing the Seine.

Conducted to Asnières.

It was claimed by thoughtful men whose attention was directed to this subject, that this disposition of the sewage polluted the waters of the river, poisoned and destroyed the fish, and also left deposits upon the banks that rendered the neighborhood below offensive and unhealthy. Various methods were proposed to remedy the acknowledged evil, one of which was the neutralizing the noxious elements of the sewers by chemical agents; another, the

Desire to prevent pollution of the Seine.

* Street but not house sewage.—Ed.

Sewage utilization.

construction of a covered or subterranean aqueduct large enough to convey the contents of the sewers to the ocean near Dieppe, a distance of about 125 miles. The most practicable proposition, however, seemed to be the use of the sewage as a fertilizer for the increase of agricultural and horticultural products in the vicinity of Paris. A large tract of very poor, infertile land, lying within a large horseshoe bend of the river Seine, near Asnières, called the plain of Gennevilliers, seemed specially suited for experiments in this direction. The whole region is very flat, much of the land sandy, gravelly, thin, and incapable in its natural state of producing remunerative crops. Experiments were commenced as far back as the year 1868 at Gennevilliers, under the direction of M. Alfred Durand-Claye, engineer of the bridges and causeways of Paris, and have been continued under the patronage of the city government to the present time, with results regarded as very satisfactory and affording a practical solution of the difficulties of disposing of the sewage of the city of Paris. The plain or commune of Gennevilliers contains about 3,300 acres, of which, in 1869, only 7 hectares (about 17 acres) were irrigated with the water from the sewers. The amount steadily increased until in 1877 about 800 acres were thus irrigated, in all cases with greatly increased productiveness, and results claimed to be every way satisfactory. The work of preparing for the distribution of the sewage is done at the expense of the city government, and is furnished gratuitously to all the landholders who will use it. Expensive conduit pipes, drains, and trenches of masonry traverse the fields; from these trenches little valleys are cut laterally through the fields between the rows of growing crops, through which the fertilizing streams can be directed at pleasure. Powerful steam-engines with large centrifugal pumps are stationed at the point where the "grand collecteur" from the sewers discharged its contents into the Seine, and the waters are forced into elevated reservoirs, from whence they are carried in underground pipes to the various sections irrigated.

The farm at Gennevilliers.

Alfred Durand-Claye.

Force-pumps.

Distribution.

Considerable opposition existed formerly, and many objections were made by the proprietors of the lands at Gennevilliers to the use of the sewage, which the government of the city took a very practical way to counteract. A piece of sterile land was purchased, and a "model garden" established, where the sewage was used, and its advantages demonstrated in the abundant production of market vegetables, farm crops, nursery stock, fruit trees, etc. Land which had

Experiments to convince opponents of the system.

hitherto been regarded as not worth cultivating, and which had no rentable value, was made both productive and profitable. The productiveness of better lands was doubled, and in some cases quadrupled, and the benefits derived from the use of the sewage water is no longer questioned. The value of the lands both for sale and for rent has largely increased; lands which, before the irrigation was introduced, rented for 90 fr. to 100 fr. per hectare, now bring from 300 fr. to 500 fr.

Sewage utilization.

The value of the system.

A commission of inquiry was appointed in 1876 by the government to examine and report upon this subject, and made an interesting and exhaustive report, through M. Schloesing, the principal points of which may be summarized as follows:

Report of a commission of inquiry, 1876.

1. The diversion of the waters of the sewers into the Seine produces a state of things that cannot be permitted to continue, and measures should be adopted, at any cost, to preserve the purity of the river, disinfect the sewage waters, and at the same time to secure their utilization to the greatest extent possible.

2. The insalubrity of the sewage waters proceeds from the organic substances, soluble and insoluble, which they contain.

3. The best of all methods of purification is filtration through the soil.

4. In order that all danger of insalubrity may be removed, it is necessary that the sewage water shall not accumulate in the soil to saturation, and thus be mingled with the water in the soil below, there to lose, by slow evaporation, all the organic substances with which it is charged.

5. The purifying power of the soil is limited, but having ascertained the nature of the soil and the composition of the sewage water, its powers may perhaps be determined by observation and calculation.

6. The impurities of the waters of the sewers are, as their composition indicates, eminently adapted to the nutrition of vegetable products, and constitute an excellent fertilizer.

7. The purification and the utilization of the sewage water are two distinct questions. The growing crops, which cover a given portion of ground, are not able to utilize as much of the waters as the same area can depurate, but the difference is not believed to be very considerable.

Commission of 1877.

A subsequent commission, appointed in 1877 to investigate the processes of horticulture by the aid of the water of the sewers, fully indorsed and adopted the report of the previous commission as a basis for their own work. This commission consisted of M. Hardy, director of the gardens at Versailles, president; Charles Joly, vice-president of the Central Horticultural Society; M. Luizier, secretary of the Mutual Aid Society of the Market Gardeners of the Seine; M. Michelin, secretary of the Horticultural Section of the Agriculturists of France; and Henry Vilmorin, reporter, member of the Tribunal of Commerce and secretary of the Central Horticultural Society of France.

This commission contains some of the most intelligent and practical men connected with the horticultural and agricult-

Sewage utilization.

ural interests of France, and they report most favorably of the experiments at Gennevilliers. The use of the sewage has been in all cases profitable, and is rapidly and steadily increasing. They quote M. Bavral for the statement that the productiveness of the irrigated lands had risen from 200 fr. and 500 fr., before irrigation, to 1,500 fr. and 3,500 fr. per hectare, and that the net proceeds of lands irrigated with waters from the sewers was often five times greater than from non-irrigated lands in the same locality.

Report of the commission of 1877 on the value of the system at Gennevilliers.

The following figures were obtained by the commission upon the place, showing the productiveness of the Gennevilliers fields:

Crops.

Artichokes (globe), 36,000 to 50,000, and even 80,000 heads per hectare (about 2½ acres).

Beets, 120,000 kilos* per hectare.

Beans, 15,000 kilos.

Carrots, 60,000, 80,000, and to 132,000 kilos.

Celery and celeriac, above 100,000 kilos.

Cabbages, 140,000 kilos.

Cauliflowers, 20,000 to 30,000 heads; of weight, from 35,000 to 40,000 kilos.

Garlic, 37,000 kilos.

Leeks, 60,000 kilos.

Onions, 60,000 to 80,000 kilos.

Potatoes, 30,000, 35,000, and 40,000 kilos.

Pumpkins, 120,000 to 140,000 kilos.

Salsify, 10,000 to 20,000 bunches; weight, about 25,000 kilos.

Lands formerly sterile, are reported as producing, by the use of sewage, returns of profit from market vegetables equal to that from lands of good quality in other sections where manure and water had to be procured at heavy expense.

Quality of vegetables.

The quality of the vegetables produced at Gennevilliers was found excellent; and Sieur Rothberg, a market-gardener from that place, had obtained the first prize at the exhibition of the Central Society of Horticulture in October, 1877, for an admirable collection of vegetables, in competition with all the market-gardeners in the department of the Seine.

Plants of commerce for manufacturing.

Plants of commerce for manufacturing purposes—peppermint, absinthe (wormwood), and angelica—are also cultivated profitably, producing as follows:

Peppermint, 40,000 to 50,000 kilos, in two cuttings, per annum.

Absinthe, 110,000 to 120,000 kilos.

Angelica, 28,000 kilos per hectare, the second year.

The following summary of the conclusions reported by the committee above named, in addition to what has been

* The kilo is about 2⅛ lbs. avoirdupois.

said, will suffice to give a general and correct idea of the question, which they regard as both interesting and important; and that when better understood, its value will be appreciated and recognized as furnishing an almost inexhaustible source of fertility to a large and comparatively sterile territory admirably adapted to its application; and that the gradual transformation which has in past years been accomplished at Gennevilliers will be rapidly extended, and that in other vast spaces, scanty and unprofitable culture will give place to fertile gardens and rich fields, where abundant harvests will appear as by enchantment, to the great benefit of all classes of the population. The committee thus formulate their—

Sewage utilization.

Summary of the conclusions of the commission of 1877, at Gennevilliers.

CONCLUSIONS.

1. The application of the sewage water to horticultural production, particularly of the larger vegetables, is practicable, and its advantage confirmed by experience, as demonstrated by the abundance and beauty of the products obtained, their healthy growth and fine quality, and by their profitable returns.

2. Such green vegetables as cabbage, celery, spinage, lettuce, chicory, and edible roots, as well as commercial plants, such as peppermint, wormwood (absinthe), etc., are especially adapted to culture by the use of sewage.

3. The quantity of sewage water that may be absorbed upon one hectare (about 2½ acres) in actual cultivation in vegetables exceeds 40,000 cubic meters per annum; but this could probably be reduced by improved processes of irrigation.

4. The distribution of the sewage by the use of trenches (*rigoles d'irrigation*) is the mode of employment which appears the most recommendable.

5. The irrigation should be moderate, intermittent, and frequently renewed.

6. Contact of the sewage waters with the foliage and stems of the plants cultivated should be avoided.

7. It is desirable that the position of the trenches should be frequently changed.

8. It appears indispensable that, in the interests of the complete depuration as well as the utilization of the waters, their usage should be regulated, and remain provisionally gratuitous; but that the gratuity should cease and payment be required when that shall appear practicable and the best policy.

9. It is desirable that garden vegetables (*cultures potagères*) should occupy an important portion of the grounds comprised in the project presented by the engineers of the city. Nevertheless, private interests and local circumstances are the best guides for determining the division and the various products upon the irrigated territory. Signed by H. Vilmorin, *le rapporteur*.

Appearance of the model garden.

I visited the model garden (*jardin modèle*) at Gennevilliers, and its surroundings, about the middle of September, 1878, and found things in a very flourishing condition, and as described in the foregoing pages. Orchard trees in bear-

Sewage utilization at Gennevilliers.

ing, as well as smaller trees in nursery rows, were generally healthy and vigorous. Pear, peach, and apple trees were the principal kinds grown.

Principal crops.

The principal garden crops were artichokes (globe), beans, beets, cabbages, carrots, cauliflowers, celery, chicory, cresses, Indian corn, kohl-rabi, lettuce and various salad plants, onions, potatoes, pumpkins, radishes, squashes, strawberries, tomatoes, turnips, etc., all looking remarkably healthy and vigorous, both in the model garden and in the surrounding fields in the neighborhood where the sewage water was used for irrigation.

Mode of irrigation.

The water was conveyed from the reservoirs, to which it was elevated by powerful pumping machinery, to the highest side of gently sloping fields, where it traversed the whole length of the field in long and nearly level brick-lined ditches, and from thence distributed in lateral channels between each row of vegetables or plants at pleasure. In one place an artificial spring has been made from an underground collection of sewage water, which, after passage through the soil, flows out from beneath a gravelly bank, to all appearance as pure and sparkling as any natural spring water, and as absolutely free from taste or smell or any appearance of impurity.

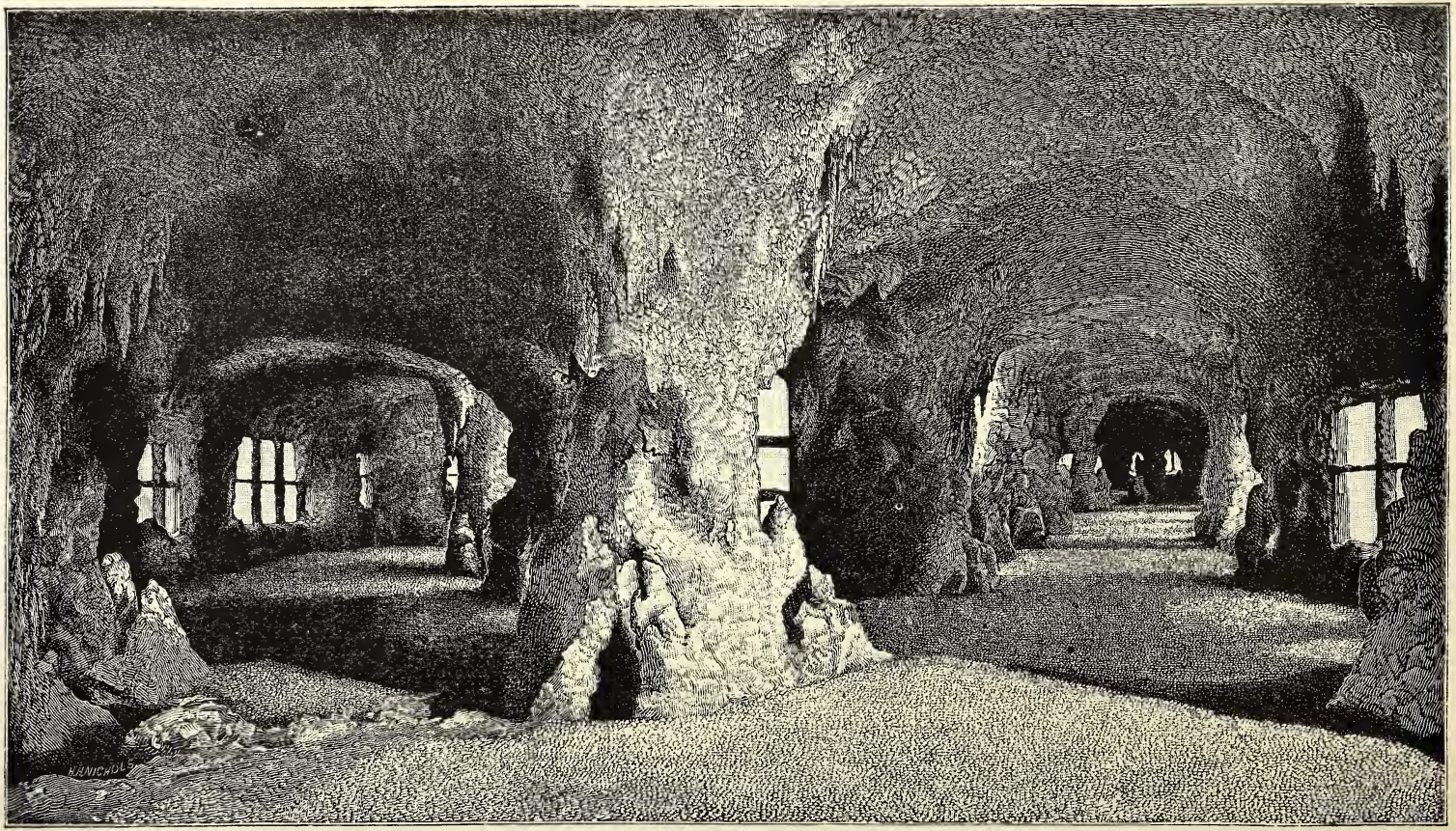
This great work has been undertaken by the city government, and performed with most satisfactory results, mainly under the direction of M. Alfred Durand-Claye, a very skillful engineer, who has been before mentioned. The expense has been great in collecting, elevating, and distributing the sewage waters and placing them at the daily disposal of the landowners in a large section adjacent to the city; but the resulting advantages, in enhancement of the value of the land by increasing its fertility and preserving the purity of the river Seine to the benefit of the public health, are regarded of greater value than the expenditure.

Success of the project.

Acknowledgments.

I desire, in conclusion, to express my obligations to Messrs. Charles Joly, vice-president, and Henry Vilmorin, secretary of the Central Horticultural Society of France; also to Mr. William Robinson, editor of the "London Garden," and author of a most interesting and valuable work upon "The Parks and Gardens of Paris." I am indebted to these gentlemen for many courtesies and facilities for obtaining valuable information.

GEO. W. CAMPBELL,
Assistant Commissioner.



FRESH-WATER AQUARIUM OF THE TROCADÉRO
Universal Exposition of 1878, *at Paris*

[Commissioner Ferguson's Report, Plate I.]

PISCICULTURE.

THOMAS B. FERGUSON.

FRESH-WATER AQUARIUM OF THE TROCADERO.
Universal Exposition of 1878, at Paris

(Commissioner Ferguson's Report. Plate I.)

PISCICULTURE.

THOMAS B. FERGUSON.

[Extract from the Official Classification.]

FIFTH GROUP.

CLASS 45.—PRODUCTS OF HUNTING, SHOOTING, FISHING, AND SPONTANEOUS PRODUCTS. MACHINES AND INSTRUMENTS CONNECTED THEREWITH.

Collections of drawings of terrestrial and amphibious animals, of birds, eggs, fishes, of cetacea, of mollusca and crustacea.

* * * * * * *

Products of fishing: train oil, spermaceti, etc. Whalebone, ambergris, shells of mollusca, pearls, mother of pearl, sepia purple, coral, sponges.

* * * * * * *

Traps and snares: fishing lines and hooks, harpoons, nets, bait, and fishing apparatus.

SEVENTH GROUP.—ALIMENTARY PRODUCTS.

CLASS 72.—MEAT AND FISH.

* * * * * * *

Salt fish: fish in barrels, cod, herrings, etc. Fish preserved in oil: sardines, tunny, etc.

Crustacea and shell-fish: lobsters, shrimps, oysters, potted oysters, anchovies, etc.

EIGHTH GROUP—AGRICULTURE AND PISCICULTURE.

CLASS 84.—FISH, CRUSTACEA, AND MOLLUSCA.

Useful aquatic animals exhibited alive. Aquariums. Processes used in pisciculture. Apparatus used in the culture of fish, shell-fish, and leeches.

REPORT

ON

PISCICULTURE.

This report presents the results of inquiries suggested by the exhibit of fish; which included fish products in general, together with implements and apparatus used for purposes of capture and of artificial production. Scope of the report.

It was a matter of surprise as well as of regret that an exhibition so replete with objects of art, and illustrating so fully most of the industrial pursuits, should have been found deficient in the particular department of which this report treats. It was natural to expect that France, having taken the initiatory in the artificial propagation of fish, under the lead of M. Quatrefages, M. Coste, M. Milne-Edwards, and others, and having set an example to the world by taking hold of the discoveries of Jacobi and utilizing the observations of Rémy and Gehin, would represent in the fullest detail the advance of this important industry in Europe. But, as will be seen, the illustration of the modes and appliances of fish culture, and of the implements and means employed in the fisheries, was exceedingly poor. Poverty of the exhibit in this class.

The fact that the Franco-German war had but recently ended, and that the bitterness of feeling which it engendered between the two nations had scarcely subsided, prevented Germany from taking any part in the Exposition beyond the contribution of some works in the department of fine arts. As fish culture occupies a more prominent place in the German Empire than in any other European nation, perhaps, the fishery exhibition no doubt suffered very materially on this account. France herself made comparatively no exhibition of fish-cultural processes, except in the oyster-cultural department. A few implements and devices employed by M. Carbonnier, and which were contained in a small building adjoining the fresh-water aquarium near the Trocadéro, constituted almost the entire French exhibit. In the case of the United States, the circumstance that no provision for co-operation was made until very near the opening Absence of German exhibits. Prominent position of Germany in fish culture. M. Carbonnier.

No exhibit in this class from the United States.

of the Exposition rendered it unadvisable to attempt any exhibition in this special department. It is to be hoped that the demand for an international exhibition of fish-cultural apparatus will be supplied by the proposed exhibition at Berlin, and that there will be brought together on that occasion an exhaustive display of the methods and devices employed in Europe.

The Berlin fish exhibition.

The subjects of investigation may be classified as follows:

A.

FISHES.

Classification of the subject.

a. Alive, for food for man, or for animals in zoological gardens.

b. Alive, for ornament.

B.

FISH PRODUCTS PREPARED FOR FOOD.

a. Fresh fish.

b. Salted, pickled, smoked, and dried.

c. Preserved in oil and hermetically sealed.

C.

IMPLEMENTS OF CAPTURE.

a. Stationary apparatus: weirs, haul-seines, trawls, purse-nets, floating gill-nets, etc.

b. Angling implements: hooks, lines, etc.

c. Explosives, poisons, etc.

D.

Apparatus used in fish culture.

E.

Laws regulating the capture of fish and providing for their protection.

As already remarked, the paucity of the exhibition rendered this line of inquiry exceedingly difficult, and made it necessary to extend the examination beyond the limits of the exhibition to the markets of Paris; while, in order to observe closely the methods employed in fish culture, a visit was required to be made to the hatching establishment at Hüningen, where this industry received its first impetus in Europe under the fostering patronage of the third Na-

Visit to points beyond the Exposition precincts.

poleon. By the cession of Alsace and Lorraine, Hüningen passed out of the control of France, and its hatching establishment has since been operated by the German Government. Hüningen.

The extract from the Official Classification on page 420 will show the groups and classes in which the subjects considered in this report were placed.

The nations exhibiting in these classes were as follows: List of nations exhibiting.

Argentine Republic.
Austria.
Belgium.
Denmark.
Finland.
France.
  Colonies:
    Algiers.
    Cochin China.
    Guadeloupe.
    Guiana (French).
    India.
    Martinique.
    Mayotte.
    New Caledonia.
    Océanie.
    Réunion.
    Senegal and dependencies.
    Saint Pierre and Miquelon.
Great Britain.
    Victoria, Australia.
Hungary.
Italy.
Japan.
Netherlands.
  Colonies:
    East Indies.
    West Indies.
Norway.
United States.

LIST OF EXHIBITORS.

The Official Catalogues containing the exhibits of these nations showed the following exhibitors, with articles exhibited. Those objects for which awards were granted by the jurors are indicated by notes, designating the respective degree of merit attained. List of exhibitors.

Mode of distinguishing the awards.

The awards will be distinguished as follows: (*) Gold medal; (†) bronze medal; (‡) silver medal; (§) honorable mention.

ARGENTINE REPUBLIC.

ARGENTINE REPUBLIC.

GROUP 5, CLASS 45.

PRODUCTS OF AND INSTRUMENTS USED IN FISHING.

LOUIS OTERO.
Fishing apparatus.

AUSTRIA.

AUSTRIA.

Fisheries on the Adriatic.

On the coasts of the Adriatic the salting, preserving, and packing of fish is carried on on a large scale. In 1875 the yield of the maritime fisheries was 71,832 metric quintals of fish with bones (39,716 of which were sardines and anchovies and 12,182 were bream); 1,948 metric quintals of cartilaginous fish; 3,014 metric quintals of cephalopods (cuttle-fish, etc.); 6,394 metric quintals of lobsters (in the preceding year this figure was 80,000 metric quintals, principally of crabs); 269 metric quintals of écrevisses; 3,683 metric quintals of mollusks; making a total of 87,177 metric quintals of sea-fish, whose value was 1,750,000 florins (about $870,000).

Statistics.

In 1875–'76 the maritime fisheries employed 2,756 vessels and 10,932 fishermen. The international commerce in fish is only remarkable on account of the importation. In 1877 there were 54,500 metric quintals of herring, 5,100 metric quintals of cod, and 24,500 metric quintals of sardines, anchovies, etc., imported into Austria-Hungary.

Exhibits.

Exhibits.

GROUP 7, CLASS 72.

MEAT AND FISH; FISH PRESERVED IN OIL.

TOPICH ANTONIO (merchant), *Lissa, Dalmatia.*
Medal of merit, 1873; medal, 1876.
Sea-fish in oil; mackerel, sardines, anchovies.
These fish are first subjected to a special salting in barrels; they are then cleaned and hermetically sealed in tin boxes filled with fine olive-oil. Fish thus prepared can be kept for many years. The boxes contain, according to the kinds of fish, 12, 15, 24, 30, 50, or 60 fish. Medals of merit at the Expositions of Vienna, 1873, and Philadelphia, 1876.

BELGIUM.

BELGIUM.

GROUP 5, CLASS 45.

Exhibits.

‡ GRANDJEAN-DEMORY, *Marchienne-au-Pont.*
Fishing rods and artistic articles; fishing rods in the form of walking sticks; bamboos.

BELGIUM.

GROUP 7, CLASS 72.

DANNEAU (Mme.), *Marchienne-au-Pont.*
Preserved fish, first quality, at 1.25 fr. (25 cents).

DENMARK.

DENMARK.

GROUP 5, CLASS 45.

Exhibits.

CLAUSEN, H. W. (firm of R. Suhr), *Nyborg.*
Oil and the residue of porpoise fat.
* ROYAL DIRECTION OF COMMERCE OF GREENLAND, *Copenhagen.*
Seal skins; whalebones; narwhal and walrus teeth; seal fat; whale and sea oil; eider down and feathers.
FEDDERSEN, A., *Viborg.*
Collection of fishing apparatus; various books on Danish pisciculture.
KJÖERBOE, SCHMIDT, ET CIE. (manufacturers), *Copenhagen.*
Cod-eggs; cod and whale oil.
STEFFENSON, O. P. (fisherman), *Skovshoved.*
Nets and fishing apparatus.

GROUP 7, CLASS 72.

‡ BRANDT, M. (manufacturer), *Ringkjoebing.*
Preserved fish.
M. Brandt commenced in 1876 to preserve fish taken in the waters of Denmark; he employs from six to eight workmen. Annual production, 12,000 frs. ($2,400).
§ KJÖERBOE, SCHMIDT, ET CIE. (manufacturers), *Copenhagen.*
Anchovies, shrimps, needle-fish, etc., preserved by different processes.
§ LUDT, A. S. (manufacturer), *Copenhagen.*
Anchovies, herring, etc.
M. Ludt commenced business in 1877, and makes the preservation of anchovies a specialty, for which purpose he uses patent glass jars.

FINLAND.

FINLAND.

Fish.

Its principal varieties of fish.

The lakes and rivers of Finland, and the sea which surrounds it, are inhabited by 80 species of fish. I will mention as among the most important, in an economical point of view, a variety of herring (*Clupea harengus*) from 75 to 100 millimeters (2″ to 4″) in length, frequenting the Gulfs of Finland and Bothnia, and found in enormous shoals near the exterior reefs of the coasts of the archipelago; anchovies (*Clupea sprattus*) which are common near the south and southwest coasts; pike (*Esox lucius*) abound in the waters of Finland as far as Lapland; the perch (*Perca fluviatilis*), which is as common as the pike; the common sandra (*Lucioperca sandra* Cuv.), which is found as high as 66° 5′ north latitude, in most deep lakes, and in the archipelago towards the south; the flounder (*Platessa flesus*); the cod (*Gadus morrhua*), common in the Gulfs of Finland and Both-

FINLAND.

nia as far as Ivarkin, but scarcer farther north; the lote (*Lota vulgaris* Cuv.), which is taken particularly in winter;

Its principal varieties of fish.

the eel (*Anguilla vulgaris* Flem.) is taken in the sea, and most rivers and lakes communicating with it; the bream (*Abramis brama* L.) is found as far as the polar circle; the *Idus melanotus;* the roach (*Leucisus rutilus*); several species of the lavaret (*Coregonus lavaretus*, L., *C. maraena* Bloch, etc.); the *Coregonus albula* L., 50 to 75 millimeters in length ($1\frac{1}{2}$″ to 2″) only, but so abundant in the lakes that it constitutes an important part of the food of the people in the interior; the salmon (*Salmo salar*), and the trout (*Salmo trutta*), which are taken in large numbers, especially in the large rivers; and singular varieties are found in the Ladogo (*Salmo relicta* Malmgr.), and in other large lakes of the country (*Salmo lacustris*); the river lamprey (*Petromyzon fluviatilis*), etc.

Amphibia.

Amphibious creatures.

These are represented by five species: the common frog (*Rana temporaria* L.), and the mute frog (*Rana arvalis* Nilss.); the toad (*Bufo vulgaris* L.), the salamander (*Triton palustris*), and the triton (*Triton aquaticus* L.).

Mollusks.

Mollusks.

These have not yet been sufficiently studied in Finland to render it possible to state the exact number of species. I will mention, among others, a kind of shore-fish which produces pearls, the *Margaritana margaritifera*, which is found particularly in streams with the Oulkjärvi, but also, though in smaller numbers, in the rivers of the south. The *Mytilus edulis* is common in the Gulf of Finland and to the north as far as Wasa, but they are not eaten any more than the different species of snails. A specimen of edible snail has been found in the south of Finland, but it is not yet known whether it can be counted in the Finland fauna.

Articulates.

Articulates.

I will confine myself to mentioning a few species which are important on account of their utility or their noxious character. Apiaculture has been somewhat developed in the south, especially in the government of Åbo and of Bjorneborg. The worm of the *Noctua graminis* does great damage, and some years almost entirely destroys the meadows in certain localities. The cone-bearing forests are sometimes attacked by the varieties of the *Hylastes scolytus* and of the *H. bostrychus*. But of all the animals of this species,

the most important in an economical point of view is the crab (*Astacus fluviatilis*), which is found in abundance in the lakes and rivers of South and Middle Finland, and of which considerable quantities are exported to Russia. Articulates.

Fisheries.

Fisheries.

The great extent of coast and the immense number of lakes make the fisheries an important source of profit to the population of Finland. According to the fishing law of December 4, 1865, the right to fish in salt and fresh water belongs to the owner of the shore, except in case this right may have been transferred to any one by sale, exchange, or for taxes. Any inhabitant of the country is authorized to fish in the open seas and on the shores, islands, and rocks which have no owner and are not lawfully occupied. Custom permits fishing with the line everywhere; the law authorizes it in the exterior archipelago and along the coasts. Fishing rights.

Associations of fishermen have been formed in the greater part of the communes in order to prevent the extermination of the fish by a bad system of fishing. The associations, which are duly legalized, engage to maintain the affluents and natural outlets of the water, to favor the development of spawn, and to use only authorized fishing utensils (for instance, nets and seines the width of whose meshes is not below a fixed minimum). For rivers and torrents in which the salmon is taken, the association fixes a time during which these fish cannot be taken, in order to allow the fish freely to visit the localities where they are accustomed to spawn. In the river Uleå it is from the 24th of August to the 1st of the following January, and in most of the other rivers from the 1st or the 15th of September until the breaking up of the ice in the following spring, except in the Wuoksi, where the prohibition ceases as early as the 15th of February. A notable increase in the number of salmon has shown the utility of this regulation. Fishing associations. Close seasons.

There are in Finland three kinds of fishing—fishing in the open seas and along the coast, salmon and sik fishing in the large rivers, and fishing in the lakes, small rivers, and archipelago of the interior. The first two constitute a real branch of industry, and are carried on without interruption during the whole time that the season and the law allow. The most lucrative kind of fishing is that of the *silakka*, or *stroemming* (*Clupea harengus*), a small herring which is found in prodigious shoals all along the coast of Finland, and which constitutes the principal food of a large part of the inhabitants. The *stroemming* is taken in nets with small meshes, Different kinds of fishing. The stroemming fishery.

FINLAND.

The stroemming fishery.

which are used at night, and which are allowed to drift with the current after having been fastened to boats. These boats are large, having no deck, and are generally manned by from two to six men. The most abundant *stroemming* fishing is near the island of Alande and in the archipelago of Åbo, and then along the coasts of the governments of Nylande and Wasa. Unfortunately, we have no data of the quantity annually taken. It is only known that from 1871 to 1875 there were sent each year from the island of Alande from 7,000 to 8,000 barrels of salt *stroemming* (a barrel contains about 127 kilos, 280 lbs.), and from the government of Nylande 2,000

Statistics.

barrels, besides what was consumed at home. In the latter government, in 1875, the sea-fisheries employed 764 boats, 3,886 nets with close meshes, and 354 seines, yielding 5,721 barrels of *stroemming*, besides other fish. It is proper to add, however, that these figures are only approximate, and very probably far below the real amount.

The sprat.

The *sprat* (*Clupea sprattus*) is less abundant than the *stroemming*. Large quantities, however, are taken at certain points on the coast towards the south and southwest. The best is that of the Ekenäs, which is known and sought after in commerce in a preserved form.

Salmon and sik fisheries.

The principal salmon and sik fisheries are in the great rivers of Torneo, Kemi, Uleå, Kumo, Kymmene, and Wuoksi. The salmon is taken either in the crawl or the seine. In Lake Ladoga, in the early part of winter, before the lake is frozen, they catch a variety of salmon with the line which rarely weighs more than 6 or 7 kilos (13 to 15 lbs.), but whose flesh is fat and savory. Thence, as well as from Kymmene, the salmon has at all times been sent to St. Petersburg, fresh and preserved in ice, while elsewhere it is salted, which deprives it of much of its value.

Statistics.

The quantity of salmon and sik taken from 1871 to 1875 in the state fisheries of Torneo, Kemi, Ijo, Uleå, and other smaller rivers of the government of Uleåborg, was—

Years.	Salmon.		Sik.	
	Kilos.	Pounds.	Kilos.	Pounds.
1871	235,900	518,980	40,290	88,638
1872	255,893	562,984	22,313	49,088
1873	219,825	483,615	22,064	48,544
1874	215,794	474,767	23,205	51,051
1875	278,140	611,908	38,950	85,690

The number taken in the state fishery on the Kumo River is not accurately known, but these fisheries being leased at 12,236 marks ($2,912) per annum, the amount taken must

be considerable. Moreover, the annual revenue of the fisheries belonging to individuals on this river is estimated at 20,000 marks ($4,760). Salmon fishery.

The most abundant fresh-water fish is the silvery lavaret. When salted it constitutes an important part of the food of the people in the interior. The spawn is sold in large quantities in the market at Helsingfors and other cities, and is very fine eating. In the archipelago and in the fresh waters the following-named fish are taken: Perch, pike, common sandra, bream, roach, rase, eel, lamprey eel, pout, trout, flounder, etc. These fish are taken either with lines, nets, wheels, or in trawls. These fisheries are carried on only as necessary to agriculture, yet they furnish more than enough for the local demand. Lavaret fishery. Other fisheries.

It is impossible to fix even approximately the quantity and the total value of the fish taken annually in Finland. The annual export to Russia and Sweden is only known by the custom-house record. The amount of this export during the last few years was as follows: Statistics of quantity and value.

Description.	1874.	1875.	1876.
Fresh fish, exported alive ..... kilos..	*88, 524	†1, 550, 970	‡1, 530, 818
Salt salmon ..... barrels..	1, 346	1, 491	2, 035
Salt stroemming ..... do....	12, 278	14, 445	16, 982
Other kinds ..... do....	947	2, 636	2, 161
Crabs ..... number..	3, 15', 050	2, 006, 050	2, 084, 033

* 1,942,925 lbs. † 3,412,500 lbs. ‡ 3,368,200 lbs.

This exportation represents a value of about 1,525,327 marks ($363,503) for 1874, 2,399,013 marks ($570,965) for 1875, and 2,685,543 marks ($639,159) for 1876. Exportation.

The seal-fishery is carried on in the open sea, and at the close of winter. The hardy fishermen advance on the ice, pushing their boats before them, until they reach the open sea. Then they row to some large mass of ice, on which they climb and allow themselves to drift with the current. If the fishing is good, the product may be 100 seals per boat. In 1875, 1,740 seals were taken in the government of Wasa, while on the island of Alande the seal-fishery produced, according to official data, only 6,700 kilos (14,800 lbs.) of fat per year, on an average, from 1871 to 1875. Seal fishery. Statistics.

In the Gulf of Finland this fishery is less productive, and scarcely exceeds 100 seals per annum. It is a singular fact that seals are found not only in Lake Ladoga, but also, as I have already remarked, in Lake Saïma.

Products of fishing.—Fish (value of production), 2,685,543 marks ($639,159), 2.72 per cent. of total expenditure; importation of fish, 1,400,000 marks ($332,200).

FINLAND.

Exhibits.

Exhibits.

GROUP 5, CLASS 45.

ADMINISTRATION DE LA PRISON D'ÅBO (*Åbo straffäugelse*), *Åbo.*
Fishing nets.

§ RENFORS, H. (manufacturer), *Kajana.*
Fishing utensils.

GROUP 7, CLASS 72.

NISKA ANNA, *Uleåborg.*
Preserved game and fish.

SANDELL, W., *Helsingfors.*
Anchovies.

STOCK COMPANY AT ULEÅBORG FOR THE MANUFACTURE OF PRESERVES.
Preserved game and fish.

STOCK COMPANY AT EKENÄS FOR SALTING FISH (*Ekenäs fisksalteribolag*), *Ekenäs.*
Anchovies; boneless herring.

FRANCE.

FRANCE.

Fish.

Whalebone.

Whalebone.—The scarcity of this article of late years has raised its price from 15 to 45 fr. ($3 to $9) per kilo (2⅕ lbs.), in a raw state, and has caused the prosperity of the manufacture of Indian whalebone, which is nothing more than buffalo horn, the price of which does not exceed 160 to 170 fr. ($32 to $34) per 100 kilos (220 lbs.).

Manufactories of fishing utensils.

Fishing utensils.—The manufactories of fishing utensils are 15 in number, 12 of which are established at Paris and one in each of the cities of Morlais, Toulouse, and Avranches. The raw materials used are copper, salt, aluminium, reed, walnut wood, elm, comel wood, privet, bamboo, hickory, spearwood, silk, hemp, flax, cotton, and the intestines of silk-worms. Artificial flies are made of birds' feathers. Everything is made by hand, even the nets, with the exception of the large instruments for sea-fishing, which are made by machinery.

Wages.

The price of a day's work varies from 6 to 9 fr. ($1.20 to $1.80) for men, and 2½ to 4 fr. (50 to 80 cents) for women.

Production.

The transactions in fishing utensils may be estimated at 2,000,000 fr. ($400,000), of which one-third is expended for raw material and two-thirds for labor and general expenses. For ten years past this branch of industry has been growing daily of more importance.

Sponges.

Sponges.—Sponges are gathered on the shores of Asia, Africa, in the Grecian Archipelago, upon the English Antilles, and in the Archipelago of Bahama. There were imported into France in 1875, 246,666 kilos (542,665 lbs.) of

sponges, of which 93,324 kilos (205,312 lbs.) were re-exported. In 1876 the imports showed 257,878 kilos (567,331 lbs.) and the imports 89,600 kilos (197,120 lbs.). The principal markets for this traffic are Paris, Trieste, and London.

Sponges.

Meats and fish.—Fish also form an important article of food. The fish of the northern seas constitute an article of valuable import, and the coastwise fisheries have reached a considerable development in certain parts of the west, which, communicating by rail with the centers of consumption, compete with those of the department of the Manche. Paris has become the central market and the point of shipment for this article.

Fisheries.

Exhibits.

Exhibits.

GROUP 5, CLASS 45.

§ BERTHELIN, *Doulevant-le-Château* (*Haute-Marne*).
Atmospheric wheelbarrow for the transportation of live fish.

* BESSOU, C., *Fécamp* (*Seine-Inférieure*).
Various fishing utensils.

† CLERET (J.-M.), *Avranches* (*Manche*).
Various fishing articles; the so-called English fishing rod a specialty.

‡ COMPAGNIE GÉNÉRALE CHANVRIÈRE (Léoni et Coblenz), *Paris.*
Twine for nets and fish-lines.

CORBIN (J.), *Paris.*
Fishing utensils.

DELABAIRE (É.), *Dunkerque* (*Nord*).
Utensils used in sea-fishing.

HOULBRÈQUE (A.), *Fécamp* (*Seine-Inférieure*).
Group of utensils and products of the local fishery.

‡ JOHNSTON (H.-S. ET CIE.), *Arcachon* (*Gironde*).
Complete drag-net.

LÉGER AÎNÉ, *Dieppe* (*Seine-Inférieure*).
Fishing utensils.

MONTENAT (A.-G.), *Paris.*
A Parisian weir.

* MORICEAU FRÈRES, *Paris.*
Fishing utensils; nets made by hand.

† NIOLLON (G.), *Marseille* (*Bouches-du-Rhône*).
Fish-hooks and fishing utensils.

ROBILLARD (A.), *Paris.*
Utensils for river-fishing.

§ ROUQUET (A.), *Dôle* (*Jura*).
Fishing rod with springs.

§ SEMELIN (T.) PÈRE ET FILS, *à la Fosse, île de Noirmautier* (*Vendée*).
Fyke-nets for shrimps and fish.

TENTROY (E.), *Avranches* (*Manche*).
Knives for cod-fish work.

‡ TRIPARD (H.), *Chenecey-par-Quingey* (*Doubs*).
Nets and snares for crabs made of iron wire.

§ TROSSEILLE (A.), *Paris.*
New model of fish-trousses; various fishing vessels; improved fish-gigs.

FRANCE.

VESQUT ET CIE., *Paris.*
Mechanical nets, seines, and drag-nets, of all sizes, for sea and river fishing; nets for sardines.

GROUP 7, CLASS 72.

Exhibits.

*AMIEUX FRÈRES, *Nantes* (*Loire-Inférieure*).
Preserved fish.

†BENOÎT FRÈRES ET RICHARD, *Nantes* (*Loire-Inférieure*).
Sardines and tunnies in oil.

*BIARDOT (A.), *Paris.*
Fish preserved by a new process, which leaves their natural color, without the use of toxical agents.

CAILLEBOTTE ET DUMAGNOU, *Paris.*
Preserved fish.

CORMIER FILS ET VÉRON (A.), *Paris.*
Preserved fish.

DELIDOU (E.), *Saint-Gilles-sur-Vie* (*Vendée*).
Comestible crustacea and mollusks.

DÉSÉGAULX FRÈRES ET CIE., *Bordeaux* (*Gironde*).
Pickled fish and tunnies in oil.

§FERRER-CALONI (L.), *Collioure* (*Pyrénées-Orientales*).
Preserved anchovies.

†FIRMIN (S.), *Croisic* (*Loire-Inférieure*).
Preserved fish.

§GILOT (E.) ET GALLAND (A.), *Paris.*
Salt and smoked fish.

†GRIVART (A.), *Douarnenez* (*Finistère*).
Fish in oil.

†ISPA (P.), *Douarnenez* (*Finistère*).
Sardines in oil.

LEMENTONNOIS (F.) ET PANIER (J.), *Granville* (*Manche*).
Dried and salted cod.

LE RAY (A.), *Palais* (*Morbihan*).
Salt fish.

†LEROUX (J.), *Port-Maria* (*Morbihan*).
Sardines in oil.

LEVESQUE (L.), *Nantes* (*Loire-Inférieure*).
Sardines in oil.

LUMINEAU ET PICHERY, *Nantes* (*Loire-Inférieure*).
Sardines and tunnies.

*MACQUET FRÈRES ET CIE., *Berck-sur-Mer* (*Pas-de-Calais*).
Salt and smoked herring.

‡OGEREAU (J. et C.) FRÈRES, *Nantes* (*Loire-Inférieure*).
Sardines and tunnies preserved.

‡PENANROS DE L'ÎLE-TRISTAN (G.), *Douarnenez* (*Finistère*).
Preserved fish.

†PETIT (J.-P.), *Paris.*
Pickled fish.

*PHILIPPE (Ch.) ET CIE., *Nantes* (*Loire-Inférieure*).
Preserved fish.

QUÉNERDU JEUNE, *Douarnenez* (*Finistère*).
Sardines preserved in oil.

SALLES (Ve. A.) ET CHATELIER (E.), *Ville-en-Bois* (*Loire-Inférieure*).
Preserved sardines.

TIROT (P.) ET POITOU, *Beaufort-en-Vallée* (*Maine-et-Loire*).
Preserved sardines and tunnies.

GROUP 8, CLASS 84.

Exhibits.

AUBRY (J.-A.), *Arès* (*Gironde*).
Oyster-cultural productions.
AUSCHITZKY (L.), *Arcachan* (*Gironde*).
Oyster-cultural productions and utensils.
AVINENC (G.), *Puy* (*Haute-Loire*).
Pisciculturał apparatus for hatching the eggs of trout and salmon.
ABRAN (M.), *Marennes* (*Charente-Inférieure*).
Oysters spawned in 1875.
† BAILLY (E.), *Caucale* (*Ille-et-Vilaine*).
Oysters.
† BALESTE (É.), *Gujan-Mestras* (*Gironde*).
Oysters.
BALLY (L.), *Marchais* (*Gironde*).
Oysters.
‡ BARBÉ-GILLES ILS, *Vivier* (*Ille-et-Vilaine*).
Oysters.
† BEAUD (J.), *Sables-d'Olonne* (*Vendée*).
Live and dried oysters.
† BERTHOULE (A.), *Basse* (*Puy-de-Dôme*).
Trout and other fish from the pisciculturał work carried on at Lake Chauvet (near Basse).
BLANC-DU-CHARRAUL (A.), *château du Charraul, canton de Loudes* (*Haute-Loire*).
Apparatus for hatching eggs of fresh-water fish.
‡ BLANCHARD FILS, *Marennes* (*Charente-Inférieure*).
Oysters spawned in 1874, 1875, and 1876.
BLANCHE (L.), *Roche-Bernard* (*Morbihan*).
Mussels from crawls.
BONNAMY, *Gujan-Mestra* (*Gironde*).
Oyster-cultural utensils and productions.
BOREL (J.-J.), *Arcachon* (*Gironde*).
Oyster-cultural apparatus and utensils.
BOUCHON-BRANDELY (G.-J.-B.) (Collége de France), *Paris*.
A treatise on pisciculture; various reports on pisciculture and oyster culture.
‡ BOIERRE, *Saint-Hilaire-du-Riez* (*Vendée*).
Salts from the Vie River; manuscripts on salt marshes and their productions.
† CAFFORET (M.) ET CIE., *Arcachon* (*Gironde*) *et Tremblade* (*Charente-Inférieure*).
Oysters; collectors with spat attached.
* CARBONNIER (P.), *Paris*.
Apparatus for hatching, raising, and transporting fish; series of aquaria stocked with indigenous and exotic fish.
CASTILLON (A.), *Bordeaux* (*Gironde*).
Oysters.
CAZAUBON ET MASSON, *Arcachon* (*Gironde*).
Oysters.
‡ CHAILLÉ (E.), *Chatressac, commune de Chaillevette* (*Charente-Inférieure*).
Oysters.

FRANCE.

CHANIAUD (E.), *Tremblade* (*Charente-Inférieure*).
Oysters.

CHAS ET CASSEL, *London*.
Various kinds of salmon.

CHEVALLIER (F.), *Avallon* (*Charente-Inférieure*).
Green oysters.

COMITÉ D' OSTRÉICULTURE DU MORBIHAN, *Auray, baie de Quiberon, la Trinité-sur-Mer, Lorient, et Vanne.*
Oyster culture; productions ; utensils; apparatus

DAUSSY (É.), *Audenge* (*Gironde*).
Oyster-hive and artificial shell-fish.

Exhibits.

‡ DELAGE (V.), *Rochefort-sur-Mer* (*Charente-Inférieure*).
Pieces of crawl with mussels and young attached.

† DELIGEY (D.), *Gujan-Mestras* (*Gironde*)
Oyster-cultural hive.

DIGNAC, *Gujan-Mestras* (*Gironde*).
Oyster-cultural productions and utensils.

DOIULLARD (G.) ET MACHAUDIÈRE, *Audenge* (*Gironde*).
Sluices and fishing utensils; products of these reservoirs.

DUSSANCE (M.), *Paris*.
Aquarium of fresh-water fish.

‡ DUTRUCH (A.), *Arcachon* (*Gironde*).
Oyster-cultural productions.

‡ GALBERT (A. DE), *Buisse* (*sère*).
Plan of the piscicultural establishment of Buisse.

GAURY (É.), *Avallon* (*Charente-Inférieure*).
Green and white oysters.

GAUTHIER (L.), *Arcachon* (*Gironde*).
Oyster-cultural productions.

GORPHE, *Andernos* (*Gironde*).
Oyster-cultural productions.

† GOUBIE-BROWNE ET CIE., *Arcachon* (*Gironde*).
Oyster-cultural utensils and productions.

‡ GOUIN (A.), *Chapus* (*Charente-Inférieure*).
Wooden model representing the Sendre; oyster-hurdles, with apparatus; oyster-cultural establishments; transport boats in motion; accessories.

* GRANCENEUVE (A.), *Arcachon* (*Gironde*).
Oyster-cultural productions.

* GRENIER (F.), *Arcachon* (*Gironde*).
Oyster-cultural utensils and productions.

* GRESSY (A.), *Carnac* (*Morbihan*).
Oysters; oyster-cultural apparatus.

GUIET (J.-J.), *Arvert* (*Charente-Inférieure*).
Green oysters; garnished tiles.

‡ HAIMAN (E.), *la Teste* (*Gironde*).
Oyster-cultural productions; various kinds of collectors; implements.

* HALNA DU FRÉTAY (F.), *Pont-l'Abbé*.(*Finistère*).
Plan, in relief, of reservoir for crustacea.

‡ HEDDE (A.), *Puy* (*Haute-Loire*).
Apparatus for transporting live fish.

JOHNSTON (W.), *Arcachon* (*Gironde*).
A complete drag-net.

KEMMERER, *Saint-Martin-de-Ré* (*Charente-Inférieure*).
Manuscripts and treatises on fish culture.

LA BLANCHÈRE (H. DE), *Paris.*
A reduced copy of a mosaic discovered at Lyons, the border of which represents numerous fishes; paper on the kinds of fish known in ancient times.
LACHOUX (J.) ET VILLENEUVE (F.), *Saint-Vivien* (*Gironde*).
Oysters of Saint-Vivien and Richard.
LAMBERTU (A.), *Arès* (*Gironde*).
Oyster-cultural productions.
LE BRÉTON (E.), *Paris.*
Water-cress aquarium.
LEHŒRFF (F.-M.), *Caucale* (*Ille-et-Vilaine*).
Oysters.
‡ LEMAÎTRE (J.), *Caucale* (*Ille-et-Vilaine*). Exhibits.
Oysters.
LE MÉVEL (V.) ET CIE., *Caucale* (*Ille-et-Vilaine*).
Oysters.
† LEROUX (B.), *Trinité-sur-Mer* (*Morbihan*).
Oysters and various kinds of sea shell-fish.
* LEROUX (H.), *Sables* (*Vendée*).
Oysters; mollusks; explanatory paper.
LESCA (F.), *la Teste* (*Gironde*).
Oyster-cultural utensils and productions.
* LESCA (L.), *Bordeaux* (*Gironde*).
Model of reservoir for fish.
MAILLARD (A.), *Paris.*
Eels taken at their birth; essays on breeding and preservation in fresh and salt water.
MARCHAND (B.-T.), *Paris.*
Aquarium for fresh-water and sea fish.
‡ MARION (J.), *Paris.*
Transport for live fish; transport for fish-eggs artificially fecundated; reservoir for fish.
MAS, *Andernos* (*Gironde*).
Oysters.
MASLIEURAT-LAGÉMARD (G.-E.), *Salagnac* (*Creuse*).
Wooden box for hatching fish-eggs.
* MAUDUIT (H. DE) ET SALMINIHAC FRÈRES (DE), *Château de Belon* (*Finistère*).
Gathering, breeding, and fattening oysters; processes; utensils; productions.
MICHELET (J.), *Arcachon* (*Gironde*).
Oyster-cultural utensils and productions.
MILLET (C.), *Paris.*
Aquicultural apparatus; maps, plans, works, and publications.
* MONTAUGÉ (DE) FRÈRES ET CIE., *la Teste* (*Gironde*).
Plans of their oyster establishments and parks.
MOREAU-SCLAFER, *Paris.*
Oysters preserved in glass jars.
† MOUNIER (É.), *Sables-d'Olonne* (*Vendée*).
Live oysters; live palourdes.
PARET ET CIE., *Paris.*
Trout of all ages.
PATINET (C.), *Arallon* (*Charente-Inférieure*).
Green and Portuguese oysters.

FRANCE.

PEYCHAUD (E.), *Bordeaux (Gironde)*.
Oyster-cultural utensils and productions.
PHILIBERT (J.), *Feurs (Loire)*.
Fish from the ponds in the Plain of Farey.
POIRIER (H.-E.), *Paris*.
Natural sea-water preserved pure with all its properties, and rendered imputrescible by a new process; aquarium for containing crustacea, etc.
*POZZY (M.), *Sarzeau (Morbihan)*.
Oysters raised by artificial means, with hatching apparatus.
‡PULLIGNY (DE), *Paris*.
Exhibits. Plan, in relief, of transformations made in various marshes and rivers which have become breeding places for fish and crustacea.
RAVENEAU (A. F.), *Paris*.
Apparatus with an orifice for the forcing of oxygen into the water of aquaria, artificial rivers, reservoirs, etc.
‡PAVERET-WATTEL (C.), *Paris*.
Ichthyological map of France.
RICO (B.), *Clermont-Ferrand (Puy-de-Dôme)*.
Dead fish, skeletons, and eggs, preserved, stuffed, cast in plaster, and colored; live fish of the Cyprinidæ family.
‡RIVASSEAU, *Bourcefranc (Charente-Inférieure)*.
Oysters.
ROBIN (A.-G.), *Villeuve-sur-Lot (Lot-et-Garonne)*.
A new system of oyster-culture; rock collections, borders for hurdles, etc., all of earthenware.
ROTHSCHILD (J.), *Paris*.
Books; plates of aquaria and fish.
†SOLMON (S.), *Maine-Simon, près Étaules (Charente-Inférieure)*.
Oysters.
SEIGLE (J.), *Caucale (Ille-et-Vilaine)*.
Oysters.
SICORD (A.), *Marseille (Bouches-du-Rhône)*.
Live plants from the Mediterranean Sea and from seed-beds; salts and plants produced naturally out of water under certain circumstances; tables indicating the natural saltness and freshness of sea-water; albums, etc.
†THOMAS, *Château de Kejeau, par Brest (Finistère)*.
Oyster-cultural utensils.
THURY (DE), *Château de Cassieu (Gironde)*.
Oyster-cultural apparatus.
TIZON (C.), *Caucale (Ille-et-Vilaine)*.
Oysters.
TURLURE (H.), *Kermélo (Morbihan)*.
Oyster-cultural hives.
VENOT (G.), *la Teste (Gironde)*.
Oyster-cultural processes, utensils, and implements; live specimens.
VILLERS, *Bayeux (Calvados)*.
Mussels; oysters.

Algeria.

ALGERIA.

Fisheries.

Fisheries.

The water-courses of Algeria, being dry during the warm season, are not conducive to the multiplication of fish. The contemplated construction of large reservoirs may obviate

this difficulty, allowing the application of fish culture with the hope of similar results to those attained by the reservoirs of Dordogne, Vanne, etc.

Coral.

Coral.—The richest and most valued coral banks are found in the Mediterranean Sea, but particularly on the coasts of Algeria and Tunis. From the commencement of the sixteenth century to the year 1794 France had almost exclusive possession of the coral fishery on the coasts of Africa. La Calle (a province of Constantine) became the principal establishment of a company founded by the inhabitants of Marseilles, who, by means of a rental paid to the state, acquired the monopoly of this industry and rendered it a very flourishing one. The suppression of this monopoly in 1794, and the liberty of concurrence offered to the Italians and to the Genoese, led to the ruin of the coral industry in France and threw it into the hands of Italy, who now finds herself mistress of the market. The rental of 800 fr. ($160) paid to France by the fishermen's barks is insufficient, and hardly covers the expenses of inspection.

Statistics of the coral fishery.

The coral fishery on the coast of Algeria is very fertile; it yields, according to M. Lacaze-Duthiers, an annual return of about 30,000 kilos (66,000 lbs.), estimated at about 2,500,000 fr. ($500,000). This original value, transformed by industry, represents commercially from 11,000,000 to 12,000,000 fr. ($2,200,000 to $2,400,000). Thus, it is evident it would be to the greatest interest of France to adopt a combination which, without leading to the freedom of the coral fishery, would excite the Algerians to pursue the industry and commerce of wrought coral.*

Sponges.

Sponges.—Various experiments attempted since 1858 have shown that sponges of the finest texture, comparable to those collected on the coasts of Syria, exist on the Algerian shore. There is in this, as well as in the coral fishery, a source of industry and of fortune, which the Algerian merchant marine is beginning to seriously consider.

Exhibits.

Exhibits.

GROUP 5, CLASS 45.

HERBET (A.), *Paris.*

Coral, crude and manufactured.

MARINE SERVICE, *Algiers.*

Special exhibition of instruments and other material used in the

* Interesting details on the coral fishery in Algeria can be found in the following works:

"Natural History of Coral: organization, reproduction; coral fishery in Algeria; its industry and commerce." By M. Lacaze-Duthiers.

"Coral Fishery on the Coasts of Algeria." By M. Cavelier de Caverville (Maritime and Colonial Review, May and June, 1878).

"History of La Calle." 1878. By M. Ferand.

FRANCE.

Algeria.

fishing and working of coral, prepared under the direction of M. Admiral Dupin de Saint-André (marine commandant), Algiers:

1. Sample of coral-boat and implements, built by Noto Brothers, Calle; price, 450 fr. ($90).

Exhibits.

2. Water-color painting, by M. de Pajol, representing three coral-boats on fishing grounds.

3. Coral rock presented by M. Gaetano, of Bône; value, 150 fr. ($30).

4. Three blocks of coral, presented by M. Palmarino, of Bône; value, 55 fr. ($11).

5. Samples of rocks, branches of coral, madropores, sponges, etc., collected on the coasts of Africa.

GROUP 7, CLASS 72

AVELLINO, *Calle* (*Constantine*).
Sardines in oil.

CARVIN PÈRE ET FILS, *Algiers.*
Sardines; anchovies; tunnies in brine.

CHAUVAIN FILS, *Phillippeville* (*Constantine*).
Fish in oil.

GARCIA, *Cherchell* (*Algiers*).
Anchovies and sardines in brine.

NIELLI FRÈRES, *Phillippeville* (*Constantine*).
Preserved fish.

PLASSE (C.), *Algiers.*
Preserved fish.

SIDER, *Phillippeville* (*Constantine*).
Salted and preserved fish.

Cochin China.

COCHIN CHINA.

GROUP 5, CLASS 45.

DUONG VAN NINK, *Binh Hoa* (*Saïgon*).
Fish-models.

§ HUINH KHAI QUAN, *Sadec.*

Exhibits.

Fish-oil.

INSPECTION DE BARIA.
Fishing implements.

JORE.
Turtles.

LOCAL SERVICE DE RACH GIÂ, *Rach Giâ.*
Fishing implements.

LOCAL SERVICE DE SADEC, *Sadec.*
Fishing implements.

LOCAL SERVICE DE SAÏGON, *Saïgon.*
Shark-fins, tortoises, etc.

Guadeloupe.

GUADELOUPE.

GROUP 5, CLASS 45.

Exhibits.

§ BEAUPERTHUY, *Saint-Martin* (French quarter).
Fish; crustacea.

French Guiana.

FRENCH GUIANA.

GROUP 5, CLASS 45.

Exhibits.

‡ COMITÉ CENTRAL D'EXPOSITION, *Cayenne.*
Isinglass.

FRANCE.

GIRAUD, *Quartier de Kourou.*
Shells.

French Guiana.

POUGET, *Cayenne.*
Isinglass in bladders.

Exhibits.

VOISIN (F.), *Approuague.*
Fish-bones.

INDIA. *India.*

GROUP 5, CLASS 45.

† CASTAING, *Paudichéry.* Exhibits.
Fish-oil.
LOPÈS, *Mohé.*
Fish-oil; isinglass.

GROUP 7, CLASS 72.

CASTAING, *Paudichéry.*
Dried fish.
COMITÉ D'EXPOSITION, *Mohé.*
Dried fish.

MARTINIQUE. *Martinique.*

GROUP 5, CLASS 45.

* BELANGER (C.), *Saint-Pierre.* Exhibits.
Collection of fish.

MAYOTTE. *Mayotte.*

GROUP 5, CLASS 45.

ADMINISTRATION LOCALE. Exhibits.
Tortoise-shells.

NEW CALEDONIA. *New Caledonia.*

GROUP 5, CLASS 45.

CHATIN. Exhibits.
Fish-nets and various implements used in fishing.
JOUSSEAUME (Dr.).
Collection of shells.
LAMBERT (R.-P.).
Shells of New Caledonia.
LÈQUES (F.), *Noumea.*
New shells.

OCÉANIE. *Océanie.*

GROUP 5, CLASS 45.

§ AMIOT (E.). Exhibits.
Sponges; mother-of-pearl; pearls.
BONNET.
Oyster-pearls; tortoise-shells.
COMITÉ D'AGRICULTURE ET DE COMMERCE, *Papeete.*
Coral productions; pearl-shells and oyster-pearls; pearls.
GILBERT-PIERRE.
Shells and corals.
GILBERT PIERRE (Dame).
Corals from the Society Islands.
JAUSSEN (T.), *Papeete.*
Collection of pearls from the Gambier Islands.
MAUSON ET CIE.
Pearls.

FRANCE.

Océanie.

Exhibits.

MARIOT.

Shells produced from pearl; whale-teeth; weapons of defense against the sea-elephant.

Réunion.

RÉUNION.

GROUP 5, CLASS 45.

Exhibits.

† POTIER (J.), *Saint-Denis.*
Fishing implements.

GROUP 7, CLASS 72.

LACAZE (E.), *Saint-Pierre.*
Preserved fish and turtles; sardines in oil.

Senegal.

SENEGAL AND DEPENDENCIES.

GROUP 5, CLASS 45.

Exhibits.

ALLYS (V.), *Saint-Louis.*
Isinglass.
CAMINADE, *Saint-Louis.*
Fish-oil.
† COMITÉ D'EXPOSITION, *Saint-Louis.*
Collection of natural history, including fish, turtles, mollusks, crustacea, various harpoons, and fish reservoirs.
DORLODAT, *Saint-Louis.*
Fishing implements of the Toucouleurs (lances, bow-nets, etc.).
§ GEST, *Dakar.*
Isinglass.
GOLTDAMMER, *Paris.*
Isinglass from Senegal.
‡ MARC-MERLE NEVEU ET ROBERT, *Saint-Louis.*
Isinglass; fish-oil; fish-scales.
SAYER (Captain), *Bakel.*
Harpoons for crocodile-fishing.

Saint-Pierre and Miquelon.

SAINT-PIERRE AND MIQUELON.

GROUP 5, CLASS 45.

Exhibits.

BROQUANT ET CIE., *Dunkerque* (*Nord*).
Nets used for fish of Saint Pierre and Miquelon.
COMITÉ D'EXPOSITION.
Collections of natural history, including fishing implements.
LEMARÉCHAL (A.), *île aux Chiens.*
Oil from brown cod.
PEPIN (T.), *Saint-Pierre.*
Cod liver oil.
RICHE.
Cod-liver oil.
VICTOIRE (Sœur), *Saint-Pierre.*
Cod-liver oil.

GROUP 7, CLASS 72.

ARONDEL (P.), *île aux Chiens.*
Cod-tongues.
BOREL (A.), *île aux Chiens.*
Dry cods.

FRANCE.

Saint-Pierre and Miquelon.

Exhibits.

CHAUVIN (É.), *île aux Chiens.*
Cod-heads.
COMELET FRÈRES.
Salt fish.
DOLISIE, *Saint-Pierre.*
Capelans in brine.
DRAYER (P.), *île aux Chiens.*
Capelans.
LEFLAY (J.).
Cod.
MAILLARD (P.), *île aux Chiens.*
Cod; capelans.

GREAT BRITAIN.

GREAT BRITAIN.

GROUP 5, CLASS 45.

Exhibits of fishing tackle, etc.

*ALLCOCK (SAMUEL) & CO. (manufacturers), *Redditch.*
Fish-hooks, fishing rods, fishing reels, sea and river lines, artificial baits, artificial flies, silk-worm gut, etc.
*BARTLETT (WILLIAM) & SONS (manufacturers), *Redditch.*
Fish-hooks, fishing tackle, fishing rods, silk-worm gut for fishing purposes.
*BUCHANAN (JAMES) (manufacturer), *Glasgow.*
Sea fish-hooks of all descriptions.
‡DICKSON (WILLIAM) & CO. (Manufacturers), *Edinburgh.*
Salmon and trout fishing rods with improved lock-fast joints; improved landing poles, nets, reels, and other fishing appliances.
RYDER (WILLIAM HENRY) (manufacturer), *Birmingham.*
Fishing winches and tackle; new method of fixing reel or winch to rod, so that the rod, held in any position, balances in the hand.
STUART (JOHN & WILLIAM) (manufacturers), *Musselburgh, Scotland.*
Cotton and hemp prepared, spun, and twisted in exhibitors' mills, and woven into nets by machinery constructed by exhibitors. The herring-mackerel nets are made 800 meshes in breadth and up to 1,000 yards in length. A selvage of stout cord is woven, and can be knitted on the top and bottom as usually required by the French fisheries. The size of the rows of meshes is accurately mentioned, and the knots are firm and cast on the best principle.
§WOODFIELD (WILLIAM) & SONS (manufacturers), *Redditch.*
Fish-hooks and general fishing tackle.
§WRIGHT (ROBERT) (manufacturer), *Edinburgh.*
Fishing rods, reels, and lines; grilse, sea-trout, loch, and river flies; landing nets and wading boots, stockings, and angling gear.

GROUP 1, CLASS 72.

Exhibits of products.

BARNES & CO. (manufacturers), London.
Fish in tins, cooked, ready for use.
CROSSE & BLACKWELL (manufacturers), London and Cork.
Preserved fish.
KNOWLES (J. & G.) (fish-curers), *Stonehaven.*
Dried codfish, ling, etc.; smoked haddocks, etc.
LINDEMANN (Dr. ADALBERT CHARLES), Manchester.
Fresh meat preserved in glass vessels.
MOIR (JOHN & SON), (manufacturers), *Ratcliff, London.*
Various kinds of fish.

GREAT BRITAIN. PERRY (WILLIAM T. L.) (manufacturer), *Penzance, Cornwall.*

Marinated pilchards, prepared in pure malt vinegar from selected fish, with bay leaves, etc., and packed in white earthenware jars, hermetically sealed.

Exhibits. TALLERMAN (DANIEL) (importer), *London.*

A collection of preserved meat, fish, poultry, fruits, vegetables, etc.; working models of his refrigerating apparatus for transporting fresh meat, etc., by sea and by land, and for storing it on land.

WIGAN (HENRY) & CO. (importers and manufacturers of isinglass), *London.*

Isinglass.

Victoria. *VICTORIA, AUSTRALIA.*

GROUP 5, CLASS 45.

Exhibits. ST. JOHN (F.), *Melbourne.*

Case of Australian fish, as per subjoined list:

Lates antarcticus. Sea-perch.
Enoplosus armatus. Bastard dorey.
Arripis georgianus. The roughy.
Arripis truttaceus. Salmon trout.
Oligorus macquariensis. Murray cod.
Dules auratus. Murray golden perch.
Therapon niger. Murray black perch.
Therapon Richardsoni. Murray silver perch.
Upeneichthys porusus. Red gurnet.
Neotephræops zebra. Zebra-fish.
Pagrus unicolor. Snapper.
Chrysophrys australis. Bream.
Chironemus marmoratus. Kelp-fish.
Chilodactylus macropterus. Kelp-fish.
Chilodactylus nigricans. Butter-fish.
Latris hecateia. Trumpeter.
Latris Forsteri. Bastard trumpeter.
Platycephalus Richardsoni. Flathead.
Platycephalus bassensis. Common flathead.
Platycephalus lævigatus. Rock.
Trigla polyommata. Flying gurnet.
Lepidotrigla vanessa. Small gurnet.
Sillago punctata. Whiting.
Sphyræna novæ-hollandiæ. Pike.
Neosphyræna multiradiata. Skipjack pike.
Thyrsites atun Euph. Barracuta.
Histiopterus recurvirostris. Boar-fish.
Seriola grandis. Yellow-tail.
Caranx Georgianus. Silver bream.
Temnodon saltatrix. Skipjack.
Neptomenus travale. Travale.
Agonostoma diemensis. Mullet.
Glyphidodon victoriæ. Rock perch.
Labrichthys Bleekeri. Parrot-fish.
Odax Richardsoni. Stranger.
Olistherops cyanomelas. Elegant stranger.
Genypterus australis. Rock ling.
Pleuronectes victoriæ. Flounder.
Copidoglanis tandanus. Murray cat-fish.

Gonorhynchus Greyi. Sand eel.
Anguilla australis. Silver eel.
Callionymus calaneopomus.
Neocarassius ventricosus. Carp.

GREAT BRITAIN.
Victoria.

HUNGARY.

HUNGARY.

GROUP 8, CLASS 84.

Fish, crustacea, and mollusks.

‡ RÉVAY (Baron SIMON). Exhibits.
Model of a pond in bas-relief, in four large and four small glass vessels.

ITALY.

ITALY.

GROUP 5, CLASS 45.

LAMBIASE (F.), *Cava dei Tirreni* (*Salerne*). Exhibits.
Samples of tweed for fishing nets.
PAULUCCI (Marquis M.), *Florence.*
Italian extramarine malacological collection.
PREMI (B.), *Gênes.*
Tunny-oil.
TOMASI (J.-B.), *Vérone.*
Nets of silk and flax spun by hand.
§ ZILIANI (B.), *Brescia.*
Silk and twine nets for hunting and fishing; drag-nets for fishing.

JAPAN.

JAPAN.

GROUP 5, CLASS 45.

† HAKOU-BOUTSOU-KIOKOU. Exhibits.
Specimens of useful animals.
† KAÏ-TA-KOU-SHI.
Cod-liver oil.
MITSUÏ-BOUSSAN-KUAÏSHA, *Tokio.*
Fishing apparatus; marine plants of various kinds.
OUÉÇOKA (T.), *Shid-suoka* (*Suruga*).
Fishing apparatus.
YAMAMOTO (Y.), *Shid-suoka* (*Suruga*).
Fishing utensils.

GROUP 7, CLASS 72.

KAÏ TA-KOU-SHI.
Salmon and *macou* (a kind of salmon), preserved in tin boxes; sun-dried cod; oysters preserved in *shôtsiou* (a kind of brandy made with rice).
MITSUÏ-BOUSSAN-KUAÏSHA, *Tokio.*
Sun-dried fish; *iriko* (a kind of mollusk).

NETHERLANDS.

NETHERLANDS.

GROUP 5, CLASS 45.

‡ ARNTZENIUS JANNINK ET CIE. (manufacturers), *Goor.* Exhibits.
Cotton nets for the herring fisheries (raw and manufactured).

NETHERLANDS.

† BANTING ET STEFFENS (manufacturers), *Amsterdam.*

Exhibits.

Sea-weed. The sea-weed exhibited comes from the Zuiderzee, where it is fished up, then cleaned in fresh water, dried, and condensed in packages.

HOOGENDIJK (A.), *Vlaardingen.*

Fishing nets.

East India Netherlands.

EAST INDIA NETHERLANDS.

COLLECTIVE EXHIBITION OF PRODUCTS.

Fisheries

Exhibits.

Lines and Pautianak nets; exhibitor, the Sultan Sjarif Joesoef.
Fishing apparatus of Batavia.
Model of the Batavian *sero.*
Fishing apparatus of Bandjermasin.
Models of *seros* of Amboina and Hila.
Sweep-nets of Amboina.
Fishing apparatus of Amboina and Hila.
Lines and harpoons of Bandjermasin.
Sweep-nets and parts of *seros* of Billiton.
Scoop-nets of Bandjermasin.
Scoop-nets of Samarang.
Fishing apparatus of Painan; exhibitor, J. P. G. Kruijt.
Fishing apparatus of Padang; exhibitor, Torankoe Panglima Mara Oejoeb.
Nets of Bandjermasin.
Nets of New Guinea.

West India Netherlands.

WEST INDIA NETHERLANDS.

COLLECTIVE EXHIBITION OF PRODUCTS.

Exhibits.

Isinglass of the *Siluris Parkerii;* exhibitor, J. P. Haase, jr.
Collection of 18 fishes in wax, from Surinam, by M. R. Mattes, exhibitor, Royal Commission of the West Indies:

1. *Perca sexatilis.* Coulant-matouari.
2. *Silurus calichthys.* Assipa-matelot; quoiquoi assa.
3. *Erythrinus Passagail.* Warapa jerasi.
4. *Silurus calichthys.* Assipia; catharina; quoiquoi assa.
5. *Lophius pacama.* Lomp.
6. *Trygon?* Saule-botte.
7. *Perca?* Coulant-matouari.
8. *Erythrinus.* Patakker.
9. *Centrarchus cichla.* Missi nelly-accari.
10. *Gymnotus labiatus.* Logologo.
11. *Pimelodus.* Botermarmetje.
12. *Anableps tetrophthalmus.* Negenoog kassonrourauwa.
13. *Xiphossoma?* Snoek pirapau.
14. *Prochilodus.* Touroulourou-witwittie.
15. *Calichthys.* Assipa blanc; witte quiqui.
16. *Centrarchus.* Ourouenijfie.
17. *Anodus.* Arder.
18. *Chalceus.* Warokou.

NORWAY.

Group 5, Class 45.

Exhibits.

§ Borthen (T. U.), *Drontheim.*

Salted roe of cod-fish.

† Brunn (Chr.), *Bergen.*

Fishing lines.

The factory was founded in 1861, and now gives employment to 50 workmen. The value of the annual production is about 150,000 fr. ($30,000).

§ Dahl (J. O.), *Hanö.*

Fishing apparatus; drag-lines, nets, etc.

Medals at Bergen, 1865; Boulogne, 1860; Paris, 1867; Vienna, 1873; Philadelphia, 1876.

† Fishing Line Factory (Crosby Frères), *Aalesund.*

Snoods and fishing lines, braided by machinery; same braided by hand; complete samples of fishing lines.

The factory, which belongs to Messrs. Stafseth and Kraasby Bros., was founded in 1874. It employs 10 workmen, and is run by hydraulic force. The machines, which work automatically, under the surveillance of the workmen, have been patented over ten years. They export to all the cities in Norway, and to several in Sweden.

Medals, Philadelphia, 1876, and London, 1877.

† Fagerheim (net-factory), *Bergen.*

Fykes for taking herring and salmon; nets for taking cod, herring, and mackerel.

The factory, which is situated near Bergen, was established in 1873, and gives employment to 30 operatives, 20 of whom are women. The value of the annual production is about 300,000 fr. ($60,000).

Petersen (C. J.), *Christiana.*

Nets and other fishing apparatus in miniature.

Pettersen, (Hillebert), *Tromsö.*

Various kinds of fish-oils.

Rönneberg (C. E.), et Fils, *Aalesund.*

Cod-roe.

Medal, Philadelphia, 1876.

Scarborough (J. V.), *Bergen.*

Model of a new kind of fishing boat.

† Schjött (H. E.), *Bergen.*

Drag-line.

Vallö Glass Works, *Vallö.*

Glass floats.

Vedeler (M. B. V.), *Bergen.*

Purse and other nets.

Group 7, Class 72.

Aarseth (M. P.), *Aalesund.*

Klipfisk (cod, salted, then dried).

Established in 1870; gives employment to 26 operatives, 10 of whom are women and 10 children. The fish is carefully cleansed while fresh, after which it is dried in the wind, being exposed as little as possible to the influence of the sun. The principal exportation is to Scotland and Ireland.

NORWAY.

§ AMELN FRÈRES, *Bergen.*
Salt herring.
Established in 1860. Branch established at Stockholm. Importations and exportations of herring of all kinds, and other products of the fisheries.

Exhibits.

ANDERSEN (E.), *Christiania.*
Anchovies.

ANDERSEN (H.), *Haugesund.*
Fat herring and salt mackerel.

ANDERSEN (J.), *Aalesund.*
Stockfisk without skins or bones.

ASKILDSEN (H.), *Haugesund.*
Fat herring and salt mackerel.

§ ASTRUP (M. H.), *Christiansund.*
Klipfisk (salted and dried cod); *törfisk* (dried cod).

BERGEN, COMMERCIAL ASSOCIATION OF, *Bergen.*
Complete collection of the various kinds of fish which are exported from Bergen.
Medal, Philadelphia, 1876.

BERGEN, SMOKED HERRING ESTABLISHMENT OF, *Bergen.*
Specimens of red herring.
Medals at Copenhagen, 1873; Vienna, 1873; Vibourg, 1875; Philadelphia, 1876.

§ BORNHOLDT (G. J.), *Christiania.*
Anchovies.
Exportation to Denmark, England, and Germany.
Honorable mention, London, 1862; medal, Vibourg, 1875.

§ BUSCH (ULRICH), *Bergen.*
Klipfisk (cod salted and afterwards dried).

† CHRISTIANIA PRESERVING COMPANY, *Christiania.*
Preserved meats and fish.
Founded in 1873; gives employment to 20 workmen.
Honorable mention, Drammen, 1873; medal, Philadelphia, 1876.

EGIDIUS (P.), *Bergen.*
Anchovies; fat herring.
Established in 1867; employs about 12 workmen.
Honorable mention, Bergen, 1873; medal, Philadelphia, 1876.

§ EIDE (LUDOLF), *Haugesund.*
Salt herring and mackerel.

ENGELSEN (JOACHIM), *Bergen.*
Anchovies and fat herring.

§ FRÖHLICH (FRITZ S.), *Christiania.*
Roe and liver of cod, mixed.

§ GRAN (CHR. K.), *Bergen.*
Klipfisk (cod salted and afterwards dried); *törfisk* (dried cod).

HOAR ET WESNÆS, *Stavanger.*
Skinless, boneless, and other anchovies; seasoned and other herring.
Business established in 1873; now employs 30 operatives, 20 of whom are women. Exportation to Germany, Russia, France, Denmark, and Sweden.

HANSEN (THORER), *Bergen.*
Anchovies.

§ HELGESEN (H. A.), *Aalesund.*
Preserved fish.
Several first-class medals at former expositions.

NORWAY.

HENRIKSEN (J. H.), *Tromsö.*
Törfish (dried cod).

†HJORTH (FR.), *Frederikshold.*
Anchovics.
Established in 1864; employs 12 workmen. Exportation to Sleswick.
Medal, Copenhagen, 1872; Vibourg, 1875.

Exhibits.

§ ISDAHL ET CIE., *Bergen.*
Stockfisk; salt and red herring.

‡ JOHNSSEN (CHRISTIAN), *Christiansund.*
Klipfisk (cod salted and then dried); *törfisk* (cod salted); herring, cod-tongues, swimming bladders, etc.

§ JUST (C. C.), *Christiania.*
Anchovies.
Medal, Philadelphia, 1876.

‡ KNUDTZON (NICOLAY H.), *Christiansund.*
Klipfisk (cod salted and then dried).

§ KONOW (CARL), *Bergen.*
Klipfisk (cod salted and afterwards dried); *törfisk* (cod dried).

KROGH (Mlle. W.), *Bergen.*
Anchovies and fine herring.

§ LANGE (HANS), *Bergen.*
Klipfisk (cod salted, then dried).

LOTHE (ARNE), *Haugesund.*
Salt herring.

† MEYER (GERDT), *Bergen.*
Törfisk (salted cod) of various kinds.

MOWINCKEL (JOH. LUDEV.) ET FILS, *Bergen.*
Klipfisk (cod salted and then dried); *stockfisk.*

MYHROOLD (Mme. CHRISTIANE), *Christiana.*
Anchovies.
Exportation to Denmark.
Medals, Copenhagen, 1872; London, 1873.

NATVIG ET CIE., *Stavanger.*
Preserved fish and meat; anchovies; red salmon in oil.

§ NORDROCK (WM.), *Christiana.*
Anchovies and fine herring.
Medal, Philadelphia, 1876.

PETTERSEN (HILLEBERT), *Tromsö.*
Klipfisk (cod salted and then dried); *törfisk* (cod dried).

§ PUNTERVOLD (O.), *Egersund.*
Anchovies.

FACTORY FOR PREPARING FISH, *Lecrosen, Lofoten.*
Prepared fish, preserved in its own liquid.

RAAUM (A.), *Langesund.*
Anchovies.

RÖNNEBERG (C. E.) ET FILS, *Aalesund.*
Klipfisk (cod salted and afterwards dried).

§ SCHJELDERUP (M. AUG.), *Bergen.*
Fat herring.

SCHREINER ET NILSEN, *Stavanger.*
Anchovies and fine herring of various kinds; 40 workmen. Exportation (40,000 kegs of anchovies, 25,000 boxes of fine herring, per annum) to England, France, Germany, Russia, Holland, Denmark, and Sweden.
Honorable mention, Vienna, 1873; Drammen, 1873; London, 1873.

NORWAY.

SMITH (Mme. G.), *Christiana.*

Anchovies.

Established in 1854. Annual production 1,200 kegs, 1,000 half kegs, 600 quarter kegs, 750 bottles. Exportation to Sweden, Denmark, Germany, England, America, and Australia.

Exhibits.

Medals, London, 1862; Bergen, 1865; Stockholm, 1866; Boulogne, 1866; Paris, 1867; Lysekil, 1868; Naples, 1871; Drammen, 1873; London, 1874; honorable mention, Vienna, 1873; medal, Philadelphia, 1876.

§ STOCKFLETH (Mme. G.), *Bergen.*

Anchovies.

STÖRMER (G. L.), *Svolvœr, Lofoten.*

Preserved fish and game.

SÖYLAND (B. L.), *Flekkefjord.*

Preserved fish.

§ TELLEFSEN (Mme. R.), *Christiana.*

Anchovies.

Established 1873. Annual production 10,000 kegs. Exportation to Sweden, Denmark, Germany, England, and Russia.

Medals, Berlin, 1873; London, 1873; Paris, 1875; Philadelphia, 1876.

† THORNE (CHR. AUG.), *Moss.*

Preserved food; anchovies.

Established in 1845; employs from 20 to 60 workmen. In 1874 the production was 26,400 boxes of preserves and 30,000 boxes of anchovies. Principally sold to the army and navy of Norway, and also to merchant vessels. Large quantities sold to tourists. Anchovies exported to Germany, Sweden, Denmark, Russia, Holland, England, France, and Australia.

Honorable mention, London, 1862; medals, Bergen, 1865; Stockholm, 1866; Boulogne, 1866; honorable mention, Paris, 1867; medals, Cassel, 1870; Naples, 1871; Copenhagen, 1872; Drammen, 1873; 2 medals, Gottenberg, 1873; medals, Vienna, 1873; Philadelphia, 1876.

THORESEN (Mme. H.), *Christiana.*

Anchovies.

§ TROSTERUD (Mlle. ANDREA), *Christiana.*

Anchovies.

GROUP 8, CLASS 84.

Fish, crustacea, and mollusks.

† SOCIETY FOR THE ARTIFICIAL REPRODUCTION OF THE LOBSTER, *Stavanger.*

Young lobsters, and model of reservoir used.

SÖYLAND (B. L.), *Flekkefjord.*

Maps of the river Sira and environs, with sketches of a projected route for salmon.

UNITED STATES.

UNITED STATES.

GROUP 5, CLASS 45.

Exhibits.

§ SHIELDS (J.), *Brookline, Mass.*

Fishing tackle, as silk lines and artificial flies.

‡ TOBIN (JOSEPH F.), *New York, N. Y.*

Manufactured whalebone.

FRESH-WATER AQUARIUM OF THE TROCADÉRO.
Universal Exposition of 1878, at Paris.

[Commissioner Ferguson's Report, Plate 13.]

NORWAY. SMITH (Mme. C.), *Christiana.*

Anchovies.

Established in 1854. Annual production 1,200 kegs, 1,000 half kegs, 600 quarter kegs, 750 bottles. Exportation to Sweden, Denmark, Germany, England, America, and Australia.

Exhibits. Medals, London, 1862; Bergen, 1865; Stockholm, 1866; Boulogne, 1867; Paris, 1867; Lysekil, 1868; Naples, 1871; Drammen, 1873; London, 1874; honorable mention, Vienna, 1873; medal, Philadelphia, 1876.

† STOCKFLETH (Mme. G.), *Bergen.*

Anchovies.

STÖRMER (C. L.), *Svolvær, Lofoten.*

Preserved fish and game.

SÖYLAND (B. J.), *Flekkefjord.*

Preserved fish.

† TELLEFSEN (Mme. R.), *Christiana.*

Anchovies.

Established 1874. Annual production 10,000 kegs. Exportation to Sweden, Denmark, Germany, England, and Russia.

Medals, Paris, 1873; London, 1873; Paris, 1875; Philadelphia, 1876.

† THORSEN (Chas. Fred.), *Moss.*

Preserved fish; anchovies.

Established in 1846; employs from 20 to 60 workmen. In 1874 the production was 40,000 boxes of preserves and 30,000 boxes of anchovies. Provided, also, to the army and navy of Norway, and also to merchant vessels. Large quantities sold to tourists. Anchovies exported to Germany, Sweden, Denmark, Russia, Holland, England, France, and America.

Diplomas, medals, London, 1862; medals, Bergen, 1865; Stockholm, 1866; Boulogne, 1867; honorable mention, Paris, 1867; medals, Cassel, 1870; Naples, 1871; Copenhagen, 1872; Drammen, 1873; 2 medals, Gothenburg, 1873; medals, Vienna, 1873; Philadelphia, 1876.

THORSEN (Mme. H.), *Christiana.*

Anchovies.

† TROSTRUP (Mlle. ANDREA), *Christiania.*

Anchovies.

GROUP V, CLASS 34.

Fish, crustacea, and mollusks.

† SARS, (G. O.), [illegible] REPRODUCTION OF THE LOBSTER, *Stavanger.*

Young lobsters and models of [illegible].

SÖYLAND (B. J.), *Flekkefjord.*

Maps of the river Sira and environs, with sketches of a projected route for salmon.

UNITED STATES. UNITED STATES.

GROUP V. CLASS 45.

Exhibits. † SHIELDS (J.), *Brooklyn, Mass.*

Fishing tackle, as silk lines and artificial flies.

† THOMAS (JOSEPH F.), *New York, N. Y.*

Manufactured whalebone.

FRESH-WATER AQUARIUM OF THE TROCADÉRO.
Universal Exposition of 1878, *at Paris.*

[Commissioner Ferguson's Report, Plate II.]

GROUP 7, CLASS 72. UNITED STATES.

‡ BOOTH (W.), *Portland, Oreg.*
Canned salmon.
* BURNHAM & MORRILL, *Portland, Me.*
Canned meats; salmon; lobsters; clams. Exhibits.
‡ COOK (J.) & CO., *Portland, Oreg.*
Canned salmon.
FICK & CHASE, *Baltimore, Md.*
Pickled oysters.
‡ GROCERS' PACKING COMPANY, *Boston, Mass.*
Canned salt fish.
* LIBBY, MCNEAL, & LIBBY, *Chicago, Ill.*
Canned salmon.
* MCMURRAY, LOUIS, & CO., *Baltimore, Md.*
Oysters in cans.
THURBER (H. K. & F. B.), *New York, N. Y.*
Canned meats and fish.
‡ TRIGG (GEORGE P.), *New York, N. Y.*
Boneless cod-fish.

A.—FISHES.

Exhibits of living fishes.

a. Alive, for food for man, or for animals in zoological gardens or aquaria.

FRANCE.

France was the only nation which exhibited living fish, and these comprised (1) a small collection of young trout about two and one-half inches long, which were hatched in March, 1878, and were exhibited by the College of France, under the charge of M. Chantran; and (2) a number of species which were exhibited in the fresh-water aquarium of the Trocadéro, under the superintendence of M. Carbonnier.

The only exhibitor, M. Chantran.

The fresh-water aquarium of the Trocadéro.

Aquarium of the Trocadéro.

Before considering the occupants, however, it may be as well to examine the structure of the aquarium itself, which is, perhaps, the most beautiful and successful one in the world. The accompanying illustrations are so plain and so fully picture the arrangement of the tanks as to render a detailed description unnecessary. The two views in perspective of the interior of the grottoes represent the appearance of the two passages as viewed from their point of divergence, and that of one of them as viewed from its farther end. The aquarium was constructed, under the skillful direction of M. Bavois and the immediate superintendence of M. Comboz in the quarries of Trocadéro, the former excavations having been utilized as far as practicable, and the natural rock allowed to remain in place to form the sides of the tanks and galleries. A peculiar and characteristic feature of this aquarium is that the tanks are not inclosed within

M. Carbonnier.

M. Bavois.

M. Comboz.

FRANCE.

Aquarium of the Trocadéro.

any building, but are exposed to the direct rays of the sun, which penetrate the waters from above, thus adding much to their clearness and other desirable qualities. The aquarium covers a surface of about 3,200 square meters, and is mostly subterranean, the light being admitted principally through the water of the tanks, which are situated in the center and periphery of the excavation.

Description of the tanks.

These tanks, 24 in number, are connected with each other in a gradually descending series, and the water overflowing each in succession is received into the one next below, the whole presenting, when viewed above ground, the pleasing appearance of a rivulet spanned by numerous rustic bridges and skirted by artistically planned and well-arranged walks. From these walks the visitor can observe the motions of the fish in the tanks below him, but a more accurate survey and closer observation can be had from the interior and lower level, where the fish are rendered plainly visible by reason of the effects of the light passing through the water. The

Ground-level plan, Plate III.

accompanying plan of the aquarium (Plate III) at the ground level represents very clearly the arrangement of the walks, and also the location of two rustic stairways, of 15

Mid-height plan, Plate IV.

steps each, leading from the ground level to the walks beneath, which are also delineated in Plate IV, which has a horizontal section about mid-height of the tanks, showing the arrangement of the tanks and walks.

Descent into the cavern.

On descending one of these stairways and entering the vestibule below, a pleasing effect is experienced from the sound of a small cascade flowing down the rocks into a pool below, the murmur of which relieves at the same time that it contrasts strangely with the stillness of the subterranean halls of the grotto. A more decided sensation, perhaps, is produced when the visitor observes through the glass bottoms of the tanks overhead the movements of innumerable fish, swimming apparently in mid-air, and flashing back the rays of the sun from their burnished sides.

Area of accommodation for visitors.

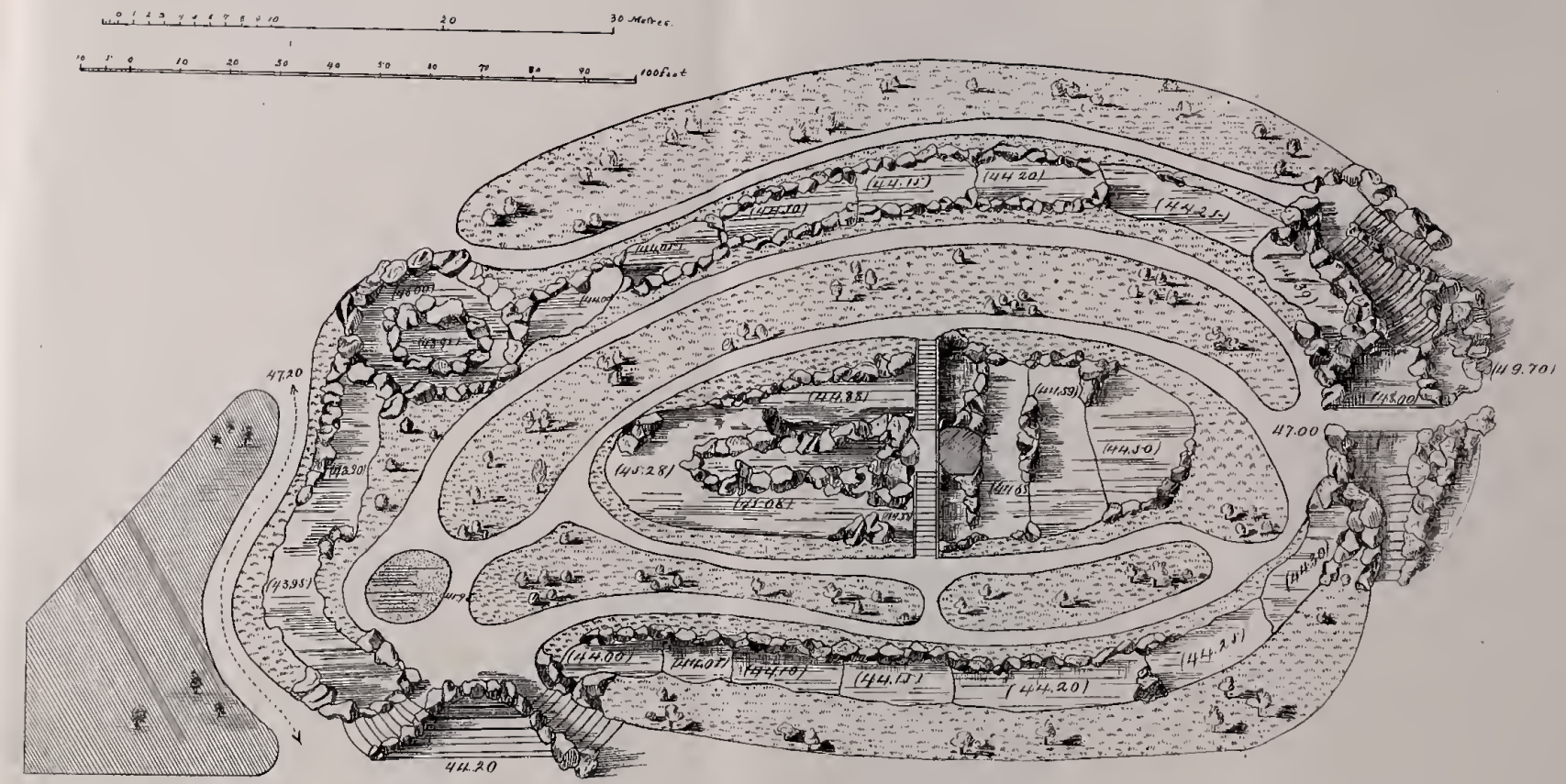
The area of the walks on either side of the tanks is sufficient for the accommodation of from 2,000 to 2,500 visitors at a time. The basins which contain the water are formed by the original excavations and artificial rock-work, made to imitate stalactites. These sustain the frames holding the

Mode of constructing tanks and glass frames.

glass plates, which are eighty six-hundredths of an inch in thickness and number about 250 in all. The water used is the same as that supplied to the city of Paris, from the head-

The water supply.

waters of the Vanne, and has a temperature during the summer of from 12° to 15° centigrade. A supply can also be obtained from the Seine if necessary. The sectional eleva-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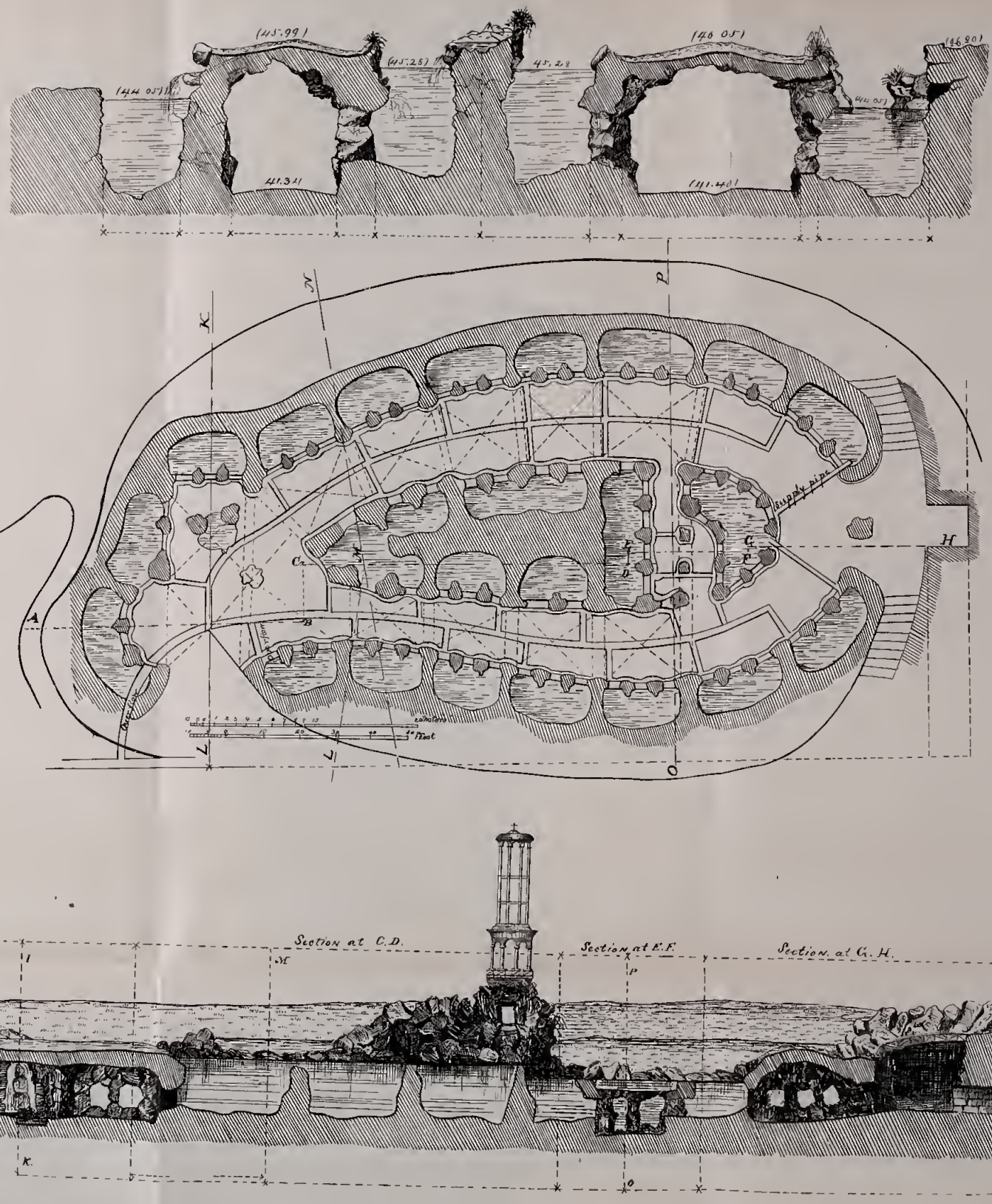
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Section at A B.
Section at C D.
Section at E F.
Section at G H.
End of Pathway
M
I
K.
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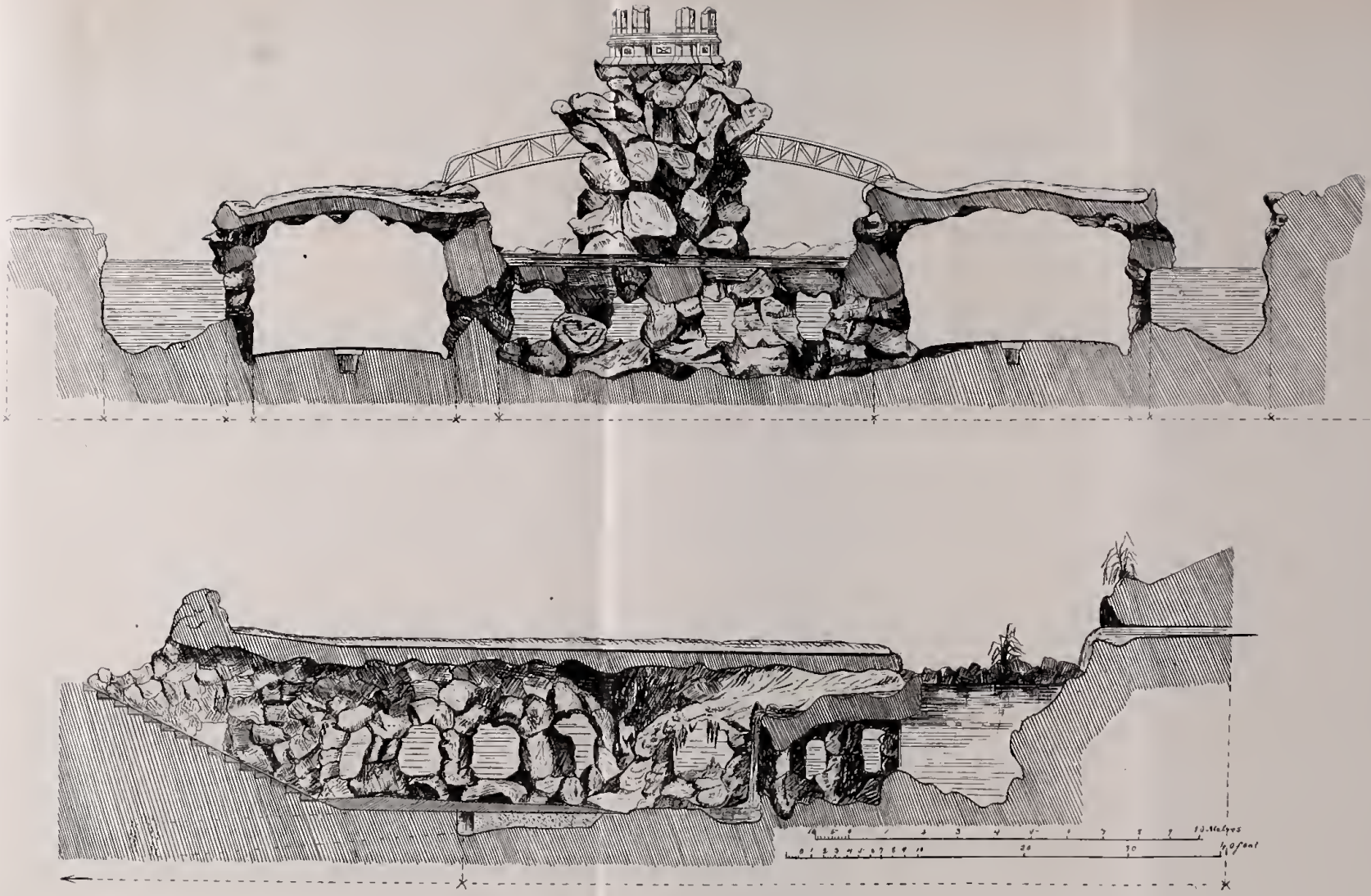


Aquarium of the Trocadéro.

tions (Plates IV and V) show plainly the general arrangements and depth of the water in the tanks at the several points.

As the water is obtained very near the source of the river, it is deficient in oxygen, and in order to supply this element, so essential to the existence of the fish, an apparatus invented by M. Gauckler, chief engineer of roads and bridges, who was, moreover, the author of the original plan of the aquarium, was constructed and placed in the center of the system, as shown in the accompanying Figs. 1 and 2.

M. Gauckler.

Water-aërating apparatus.

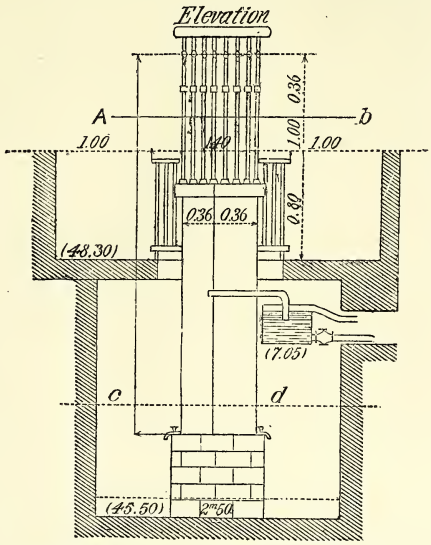


FIG. 1.—*Apparatus for aerating the water supplied to the aquarium (vertical section).*

Description.

The apparatus (views of vertical and horizontal sections of which are given) is an application of the principle of the "Catalan trumpet" which is used to operate the bellows in the iron-smelting furnaces of Spain. It consists of a number of glass tubes, into which the water is forced by hydraulic pressure, carrying with it bubbles of air, the presence and movement of which in the tubes may be plainly seen.

Capacity of tanks.

Some of the basins are about 15 feet in depth, and the total capacity of the tanks is about 2,000 cubic yards.

Cost.

The cost of the construction of the aquarium was estimated at $10,000. The plans and specifications were accurately prepared beforehand, and the following summary of the conditions of the contracts, which was issued by the engineer department, is presented here as an illustration of

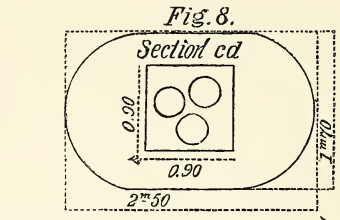
Draft of the specifications.

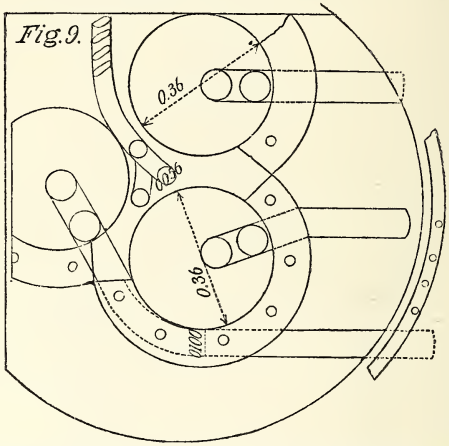
FRANCE.

Aquarium of the Trocadéro.

the completeness of the system pursued in carrying out the designs.

Water-aërating apparatus of M. Gauckler.





Specifications for the work.

FIG. 2.—*Apparatus for aerating water for the aquarium (horizontal section).*

Table showing nature of work, class and price of materials employed in the construction of the aquarium.

[NOTE.—All prices in the accompanying statement comprise delivery, hand-labor, all extras, such as royalties, octroi duties, and profits. No extra prices will be allowed except those which are especially mentioned. All masonry will be executed according to the regulation established on large public works.]

Nature of work.	Class of materials and location.	Unit.	Price per unit.	Observations.
Béton masonry in Portland cement.	Sharp sand; pebbles from the alluvial earths of the valley of the Seine; Portland cement from Messrs. Lonquéty & Co.	The cubic yard.	$3 50	The sand employed will be large-grained sea-sand, quite pure, and without any trace of earthy substance. The pebbles will come from the alluvial earths of the valley of the Seine; they will be broken to the size of 2.3″, and washed with great care when used; those which will pass through a ring of .78″ diameter will be rejected. The cement employed will come from the manufactory of Lonquéty & Co., of Boulogne-sur-Mer; it should weigh at least 2,200 lbs. per cubic yard. The mortar will be composed of 423 lbs. of cement per cubic yard of sand; the mixing, which will be made in quantities of 3.5 cubic feet of sand per 110 lbs. of cement, must be thoroughly done; the mortar will be always made and kept under covered sheds. The béton will contain 67 per cent. of pebbles; it will be made with the greatest care, and laid in thicknesses of 11.8″ as a maximum; in cases where the béton cannot be measured up, it will be counted as equal in capacity to that of the pebbles employed with one-third added.

Table showing nature of work, class and price of materials, etc.—Continued.

Nature of work.	Class of materials and location.	Unit.	Price per unit.	Observations.
Masonry in Portland cement for rock-work, walls, and pillars.	Stone from excavation; sea-sand; Portland cement.	The cubic yard.	$3 79	The contractor will employ the blocks of limestone from the excavation which will be approved of by the engineer; the blocks should be well washed before use; the price specified refers to the masonry of all kinds in which all stone belonging to the administration is employed. No extras will be allowed for the facing work, which will be rendered in cement to imitate rocks in accordance with the intention of the engineer; the quality and the nature of the materials employed for this work will be as above. The mortar will be composed for the inner masonry of 423 lbs. of cement for one cubic yard of sand; and for outer work, according to the requirements of the work, 670 lbs. of cement for one cubic yard of sand; the masonry will be measured up at nine-tenths of the cube of the blocks of stone, delivered at the foot of the work where it is to be employed. No extra price will be allowed for openings which it may be necessary to make or leave in the masonry for supply or ventilation pipes, etc.
Limestone masonry in Portland cement.	From quarries in the environs of Paris.	The cubic yard.	6 74	The limestone will come from the best quarries in the environs of Paris; only the employment of such will be authorized which have been quarried long enough to allow soft and imperfect parts to have been removed. The mortar used will be composed of 593 lbs. of Portland cement per cubic yard of large, sharp sea-sand; it will be made in the same way as described above. No extra price will be allowed for any special thickness or form of the walls where this stone is employed beyond those allowances specified further on. This masonry will be measured up as nine-tenths of the quantity of stone delivered at the foot of the work.
Extra for the decoration on natural rock.	Staircases, retaining walls, and the outside faces of galleries.	Per square yard.	80	The extra price specified opposite refers to such decorations as dressing grottoes, which will be made upon the natural rock where possible; it comprises the clearing out and constructing on the face, imitations of rock, and it also applies to the staircases made in the natural rock. This extra will be paid by the area of horizontal or vertical projection, according to the cases to which it refers; the masonry used in this decoration will be paid for at the fixed prices named in the preceding articles, according to its nature, and measured as prescribed in these articles.
Extra for the decoration of the arches to represent natural grotto-work.	Roof of galleries; arches above the glass closing the tanks.	Per square yard.	80	The extra price given opposite is applicable to all the roofs of the interior galleries, and to all arches of more than 3.28′ span situated above the glass fronts of the tanks, to pay for additional hand-labor and cement. No extras will be allowed for arches 3.28′ span or under. The galleries will resemble the roofs of limestone grottoes; the decoration must be strongly attached to the masonry of the arches, which in spite of their irregular forms must be built up in the same manner as ordinary arches in limestone; no indemnity will be granted for any iron bars or cramps employed to secure the face to the body of the arch.
Extra for the interior finishing of the tanks in cement and limestone.	Interior of the tanks	Per square yard.	1 09	These extra prices will be estimated per square yard of horizontal covered surface. The masonry used for this decoration will be measured up at the prices fixed per cubic yard in the articles above; this extra refers especially to the decoration of the tank below the water-level, as payment for the increase in hand-labor and cement, the masonry being estimated at the prices per cubic yard fixed above.

Table showing nature of work, class and price of materials, etc.—Continued.

Nature of work.	Class of materials and location.	Unit.	Price per unit.	Observations.
				it also comprises the rock excavation, fixing and the stopping up of fissures, facing with limestone 7.8″ thickness at least, and the application on all the exterior surfaces of a finishing coat in cement of .07″ in least thickness, composed of 1,100 lbs. of Portland cement per cubic yard of fine sand. The partitions between the tanks will have the irregular form of rock-work according to the instructions given to the contractor. It is also applicable to the dressing and finishing of all the wetted surfaces either of natural rock or of masonry; it will be estimated by the square yard of developed surface, taking the smallest dimensions.
Faces in stalactite and stalagmite.	Interior of galleries	Per square yard.	$2 38	The faces in stalactite and stalagmite will be measured on their horizontal or vertical projection according to circumstances, without any attention being paid to the hollow parts. For the pillars decorated in stalactite and stalagmite the surface will be obtained by multiplying the height under the roof by the mean diameter. The faces decorated in stalactite or stalagmite will be included in the extras indicated above, but all surfaces for which this decoration will be reserved will be counted at least as one square yard.
Finishing coat in Portland cement of .78″ in thickness for lining the bottom of the basins.	Lining of arches and galleries.	Per square yard.	28	The mortar for facing up will be composed of 1,100 lbs. of cement per cubic yard of river-sand, quite pure, and separated of all earthy matter.
For each $\frac{3}{8}$″ in thickness, more or less.	....do	Per square yard.	08	
Extra for the increase of the quantity of cement in masonry.	Portland cement ..	Per 22 lb. increase per cubic yard of masonry.	06	This extra will not be allowed except in cases where a formal order of the engineer involves a modification of the quantities of cement specified in the articles above; it will not be, in any case, allowed to the masonry already included in the extras indicated in the articles allowing for extras, it being understood that these extras take account of the increase in the cement necessary.
Cost of centering for arches of all heights and to 6.56′ span, inclusive.	Backs of tanks....	Per sq. yd. of horizontal covered surface.	31	The contractor will have to provide centerings for arches of all dimensions required. The drawings of such centering will be approved of by the engineer, who will decide the number of forms to be adopted; the responsibility of the contractor will not in any way be diminished by this decision.
Cost of centering for arches of all heights over 6.56′ span.	Galleries	....do	44	All materials employed in the centering will remain the property of the contractor. Openings of not more than 3.28′ span will not be considered as arches.

Obligations of the contractor.

The contractor was required to take out, to clean, to place in dépôt, and to remove, under the instruction of the engineer, to places indicated by him, the rock and stone excavated. It was also required that he should remove the stones which were to be used in the construction of the aquarium to a distance of about 200 yards, while the excavations were in progress, and afterward to replace them at the proper points. Ramming down and watering banks was only allowed under special permission from the engineer, and in such cases the watering was required to be done at

Aquarium of the Trocadéro.

the same time as the ramming. Under these conditions the following prices were established for the different kinds of work:

"The price per cubic yard of excavation of all kinds, including digging, loading, transporting, unloading, leveling up, and all other hand-labor which is indicated as coming under any allowed extra charge, 38 cents. Extra for excavating per cubic yard of rock by blasting, 30 cents. Extra per cubic yard of stone quarried from the excavations, including loading, cleaning, and removing to the places indicated in the vicinity of the Trocadéro, 30 cents. Extra per cubic yard of blocks of rock excavated, and being larger than one quarter of a yard cube, including deposit in dépôt at the places indicated within a radius of 200 yards, $1.20; the size of each block was estimated after by measuring three rectangular dimensions. Price per cubic yard of earth measured in excavation, 9 cents."

Prices for the excavation and building.

Forty-six different species and varieties of fish were contained in the tanks of the Trocadéro, quite a number of specimens of a kind being exhibited in the same tank. M. Carbonnier, who administered the aquarium during the Exposition, says in his report:

46 species and varieties of fish in the tanks.

"One can hardly imagine, without having experienced it, the many conditions which it is necessary to realize in order to secure the existence of such a number of different species, each requiring a separate dwelling place, nourishment, temperature, and water. Some require granitic and some a calcareous water, while others demand muddy or gravelly soils at bottom; some, again, exist naturally in deep water, while others live only at the surface. The salmon family live in water below the temperature of 15° centigrade, while the carp family require from 25° to 28°. The difficulties experienced in regard to temperature were also encountered in the matter of nourishment, some fish feeding entirely on living prey, some on dead animal matter, while others consumed only vegetable. Here the difficulties were less, because we knew the needs of each race; but for what concerned the various conditions of the places appropriated to each our knowledge and resources were very limited. The water of the Vanne varying from 12° to 15°, but always possessing the same constituents, a hydraulic bellows and 24 spigots were my only means of action."

Difficulties due to the different requirements of the fish.

Among other interesting exhibitions in this aquarium, that of the hatching of 35,000 eggs of the California salmon (*Salmo quinnat*) was by no means the least attractive. On the 25th of October the *Société d'Acclimatation* turned over to the Minister of Public Works 35,000 eggs of this fish, which had been shipped to the society by Prof. Spencer F. Baird, United States Commissioner of Fish and Fisheries. These eggs were transferred by the minister to M. Carbonnier, by whom they were placed in the hatching apparatus under the covered gallery of the aquarium, and in six weeks 26,000 young fish were hatched. This result afforded matter for congratulation, as evidencing both the successful care which the eggs received while in the hands of M. Carbon-

Hatching the eggs of the California salmon.

Success.

FRANCE.

Aquarium of the Trocadéro.

Eggs of the California salmon.

Hatching.

nier and the efficiency of the means employed by the United States Commission in packing and transporting them. When it is remembered that the eggs were taken (artificially) from fish caught on the McCloud River, California, and thence transported across the American continent by rail, and across the Atlantic Ocean by steamship, the loss of only 10,000 eggs was a great triumph for American fish culture. The young fish were distributed as follows:

Distribution.

To the Sarthe	5,000
To the Vienne	5,000
To the Yonne	5,000
To the Adour	5,000
To the Gave de Pau	5,000

The remaining 1,000 were placed in Tank No. 18 of the aquarium.

The safe deposit of these fish in the above-named streams was a matter of great rejoicing to the French.

Of the tanks above described, the seven to the right on entering from the southern stairway, being the deepest and containing the coldest water, were devoted to the fish of the salmon family.

Detail of the contents of the various tanks.

The following extract is taken from the report of M. Carbonnier, already referred to, and as his experiences in the management of this beautiful aquarium developed some important facts, his observations are reproduced at considerable length:

"*Tank No.* 1.

Tank No. 1.

"The first tank is the largest in the establishment, its capacity being about 130 cubic meters; it is the first to receive the water, and has been reserved for the salmon and large trout. We placed there several salmon from the Rhine, *Salmo salar*, but without success. It is true that this fish, the greatest traveler of our rivers, cannot bear seclusion; its scales adhere but slightly and fall at the least shock, after which the creature becomes covered with moss and pustules, which soon pervade its whole body and occasions death in a few days. In the evening and at night these fish spring more than a meter out of water. The longest time that I could succeed in keeping this fish alive was two weeks.

Salmon and trout.

"The salmon of the Danube, *Salmo hucho*, is more robust and more tame; its scales are smaller, and it habituates itself more readily to a sedentary life. We received two of them from Basle at the beginning of the Exposition, which withstood all the first cement. They weighed each from 6 to 8 kilos; live always together, never quitting each other unless it be to seize upon some living prey, ablet or gudgeon, passing within reach.

"Contrary to all our salmon, which spawn in winter, the salmon of the Danube multiplies in the month of May; its eggs are hatched in fifteen days.

"In the same Tank No. 1 are 25 large lake trout, *Salmo lemanus*, remarkable for their activity and the skill with which they seize upon the little fish given them for food. Aquarium of the Trocadéro.

"*Tank No.* 2. Tank No. 2.

"Advancing to the right we find a second tank, with a large front, 5 meters of water, and dimly lighted. The carbonate of lime detached from the materials of construction whitened the water for nearly three months, so that I was not able to utilize it with success till towards the second period of the Exposition. A few lavaret, *Coregonus lavaretus*, acclimated by Mr. Vincent in a lake called Settons, belonging to the state, were introduced into this tank, and have succeeded tolerably well. The feras inhabit the large and but slightly calcareous lakes of Switzerland. In spite of the lime held in solution by the waters of the Vanne, eight subjects have become very well acclimated in the aquarium of Trocadéro, and seem preparing for an approaching reproduction. Lavarets.

"In spite of the numerous attempts made during the last few years to introduce this fish into French waters, the result has always been negative.

"*Tank No.* 3. Tank No. 3.

"Tank No. 3 is at the back of No. 2, but, less extensive and lighter, affords better disposition for lodging salmonids. The water is 5 meters deep; vegetation was soon established here, and I have often relied upon it to restore and cure fish exhausted by a long journey. It has been inhabited for some months by from 25 to 28 Bavarian chars, *Salmo salvelinus*, a most beautifully colored fish, the back dark, the belly saffron-yellow, the fins bordered with a white stripe of fine effect. Bavarian chars.

"For delicacy of flesh the char is something between a salmon and a trout. We find it in France in Lake Bourget and in Lake Paladru, department of Isère. M. Ricot has succeeded in acclimating it in Lake Pavin, in Auvergne.

"The char which we have in Tank No. 3, here, during the past few months presented a rotundity of abdomen, which announces the approach of laying. This fish spawns in January of each year; I hope to be able to multiply it.

"*Tank No.* 4. Tank No. 4.

"Tank No. 4 follows No. 3; the front is large and well exposed. I first placed there about 20 red-eyes, *Leuciscus erythrophthalmus*, a variety of gardons, with red fins, a very pretty fish, but scarcely eatable. The red-eye lives in muddy ponds of stagnant water, a condition which I was not able to procure for it in the aquarium of Trocadéro. Red-eyes and carp.

"In placing it in Tank No. 4 I had rather in view to show one of our most prettily colored fish, but as by their diminutive size they did not sufficiently fill so large a tank, I added 25 carp of different kinds, some albinoes, and some with large mirror-like scales, anomalies which are perpetuated through several generations, but which always finally disappear.

"The fish of No. 4 are herbivorous. Every other day I had cooked corn thrown to them for food. Farinaceous matter has the inconvenience of whitening the water and tarnishing its transparency, but at the same time it makes it more greasy and better adapted to this species. We did not lose a single one of these fish during all the time of the Exposition.

FRANCE.

"*Tank No.* 5.

Aquarium of the Trocadéro.

"The principal front of this transversal tank is upon a passage covered with water uniting the two large galleries; there is a smaller

Tank No. 5.

front, 1 meter long, behind Nos. 2 and 4. Here the fish can roam through a body of water about 12 meters in extent; hence, I selected

Chub.

it for the chub, or *Leuciscus cephalus*, which is a great traveler. Among our white fish the chub is one of the best for eating; as it lives almost entirely upon the surface of the water, it does not contract that taste of mud which characterizes fish which live at the bottom. This tank contains some hundred of them, which have thriven quite well during all the time of the Exposition.

Tank No. 6.

"*Tank No.* 6.

"No. 6 is formed by that transparent ceiling under which spectators circulate in compact masses on Sundays and fête days. The glass forming the roof was covered with a very small bed of water, $0^{m}.50$ maxi-

Small fish for feeding the carnivorous species.

mum. In this I placed the reserve of small fish, victims intended to be given as food to the carnivorous species.

"On account of the very slight inclination of this glass, frequent cleaning was required; twice a week the deposit which formed there had to be removed, a very laborious operation, which decided me to devote this tank to fish of no special interest.

Tank No. 7.

"*Tank No.* 7.

"By its situation and extent Tank No. 7 is most fortunately placed. On the north it bounds the series of tanks of the central portion, and faces the two doors of entrance which are to be found on that side. It is open to the public on all sides. Its capacity is not less than 100,000 liters. By its position, and on account of its inhabitants, this is the veritable post of honor of the whole aquarium. In this Tank No. 7 I

Salmo fario.

have placed the trout, *Salmo fario*, which were sent to us from Bavaria and Switzerland, a greatly esteemed fish, to which I have devoted all my attention. If the possibility of raising trout in stabulation, that is, within limited space, had never before been demonstrated, I believe that now the test has actually been made.

"From the 10th of June to the 15th of July I collected in this tank 228 trout. They doubled their size in a few months; only five died during all the time of the Exposition; two of them sickened and three were choked in attempting to swallow too large prey. These trout have always been the great attraction of the aquarium.

"By attention to the distribution of food I have succeeded in accustoming them to content themselves with dead fish and to come after it even out of the water. Every time that the man in charge throws to them a handful of bleaks they spring to the surface to seize them, and seen from the exterior look like a bunch of rockets shooting into the air.

"These trout are doing very well. On the 25th of November, in a first experiment of artificial fecundation practiced upon some which had attained maturity, I obtained a laying of about 50,000 eggs, an operation which, renewed some days later upon other subjects, will give us something like 100,000 young fish of this valuable race with which to people our streams.

"*Tank No.* 8.

Aquarium of the Trocadéro.

"Leaving No. 7 and going towards the northern angle, Tank No. 8 is seen at the head of the gallery. This numbering of the tanks has been made in the direction of the flowing of the water as it comes away from the center. The water loses something of its chilliness and becomes warmer by contact with the atmosphere; the conditions of each tank, as a dwelling place, were therefore modified, and I took care to distribute my fish according to their habits and wants, placing nearer the center those which required colder water, and further along those for whom a higher temperature was necessary.

Tank No. 8.

"This Tank No. 8 contains several thousand gudgeons, or *Gobio fluviatilis*, a fish of which Parisians are so fond, and which, by its fecundity, seems to brave the thousands of fishermen who pursue it.

Gudgeons.

"*Tank No.* 9.

Tank No. 9.

"The following tank, No. 9, receives very little light. I have, therefore, selected it for a most common fish, the ide, or *Idus melanotus*, without great alimentary interest. The gardon likes green and greasy waters, and is, therefore, one of those who best endure stabulation. At first the lime corroded all their fins; afterwards, transported from the Seine into the cold water of our tanks, they let themselves die of hunger.

Ide.

"*Tank No.* 10.

Tank No. 10.

"This tank presents a beautiful front; rocks happily disposed inside attract the eye; branches of aquatic plants, *Elodea canadensis*, rooted in the sand at the bottom, cover its surface.

"This tank contains about 20 burbot, or *Lota vulgaris*, a fish of the Rhine which is much esteemed, but which seems to be disappearing more and more from the course of our streams. The rafts of floating wood which formerly came down the Seine brought to Paris many lottes, who made use of them as a sort of vehicle, and found in the bark a sort of food which approximated their own manner of life. But during the past three or four years this system of transporting wood seems to have been abandoned, and the burbot has almost disappeared from our regions.

Burbot, or eel-pout.

"Among the burbot in the aquarium of Trocadéro some weigh more than 2 or 3 lbs.; their oviaries are now largely developed, and all announces the approach of laying.

"*Tank No.* 11.

Tank No. 11.

"This tank seemed naturally intended to receive crabs; and we have several times introduced the variety known as the red-clawed, or crabs of the Meuse. In spite of the abundant food with which I supplied them, I never could keep them alive more than eight days. The place, however, appears very suitable, and I cannot account for this phenomenon. I have since bought others and distributed them with no better success; they soon died. I should have been very glad to utilize the voracity of these crustaces to clear the tanks of the small dead fish left upon the sand at the bottom. In the aquarium of 1867 these crustaces lived very well, and several even shed their coats under the normal conditions.

Crabs of the Meuse.

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Aquarium of the Trocadéro.

"*Tank No.* 12.

Tank No. 12.

"This tank is inhabited by 150 good-sized eels, weighing from 750 to 1,500 grams. In the eyes of visitors these fish have a great defect, which is that, flying the light of day, they are always seeking a shelter in which to hide themselves from the gaze of all; hidden in the sand at the bottom, or behind some stones, they allow nothing to appear but a pointed head, watching for some prey which may be easily seized. With a view to excite them, I have often had small white fish thrown in to them, but the eels have always disdained them. Gudgeons alone are their favorite food. It is by throwing some hundreds of these into the tank, after some days of fast, that I have succeeded in stimulating their appetite and making them quit their shelter. Nothing is more curious than to watch an eel in pursuit of a gudgeon; first suspended in the water, then bent like an arc, then flying out like a spring and falling upon the victim. The public has always taken a great interest in this absolutely new spectacle, collecting in such numbers before this tank that there was no passing by. It is also remarkable that the gudgeon, whose habit it is to dwell at the bottom of the water, always keeps to the surface of the tank to avoid the threatened danger, the instinct of self-preservation and the consciousness of danger thus overcoming natural instincts.

Eels.

Tank No. 13.

"*Tank No.* 13.

"This tank was first intended to receive batrachians and amphibians, but the frogs, which were first put there, not finding the cold water to their taste, emigrated *en masse*, and took refuge among the cresses of the upper stream of Trocadéro, where they found the sun insects, and the comparatively warm waters of the Seine, which feeds that stream.

Frogs.

"Gratings were placed upon No. 13 to shut in the batrachians, but the season of fishing for them had passed; we were obliged, therefore, to introduce some salamanders, which are vagabonds by nature, and always find means of escape. These are almost land animals, and frequent the water only at the time of their loves.

Salamanders.

"Later, I collected in this tank about a thousand beautiful bleaks, or *Alburnus lucidus*, with silvery scales, and always in motion. A few days after these fish began to lay, and the tank became peopled by thousands of young, which, however, got away through the gratings for the overflow; the greater number were devoured by their congenitors, a ferocity which puts a check to the too great fecundity of this species of fish.

Bleaks.

Tank No. 14.

"*Tank No.* 14.

"This well-arranged tank was intended to lodge the lampreys of Dordogne, or *Petromyzon marinus*. Mr. Gauckler, chief engineer of the Vosges, sent to Bergerac one of his agents, Mr. Bienner, who, with the assistance of a fisherman of Dordogne named Tamiset, after a thousand tribulations, succeeded in getting to the aquarium of Trocadéro 58 large lampreys and 225 ammocetes, or larvæ of lampreys.

Lampreys.

"These fish, so much esteemed by the Romans, and upon which Lucullus fattened, could not easily accommodate themselves to the not very nourishing waters of the Vanne. After the first week the small ones had emigrated, in all senses of the word, and about half the large ones had perished. I was able, however, to preserve the survivors, which were objects of great curiosity to the visitors of the aquarium. To-day, December 15, I have still eight, but they are condemned to die within a few months.

Aquarium of the Trocadéro.

"The mode of life of these creatures is most singular. When they have undergone their complete metamorphosis they leave the sea and go up rivers to lay. When the act of reproduction is accomplished they die, leaving to their descendants the care of providing for the creation of a new generation.

Tank No. 15.

"*Tank No.* 15.

"This compartment, the darkest in the aquarium, is obscured by water falling like a cascade into the first vestibule. Tank No. 15 is approached under a rocky archway.

Barbel.

"Little seen, and receiving but a diffused light, I devoted it to the barbel or *Barbus vulgaris*, which could not be kept in any other part of the aquarium. I prolonged their existence somewhat, but never could succeed in making them live long in the aquarium of Trocadéro on account of the nature of the water used in the establishment.

"The barbels caught in the Seine, where the water stands from 22° to 25° centigrade, and transported to our tanks, where the temperature is only from 12° to 15°, experience under the influence of the cold an abdominal contraction, and are able to take no nourishment. They live upon their own fat, but after some days even this provision is exhausted and death is prompt and certain for all.

Tank No. 16.

"*Tank No.* 16.

Infirmary for fishes.

"This tank forms a right angle with the preceding one, and has a fine exposure. A very active vegetation was produced here from the beginning, and I have always used it as an infirmary for the sick; when I have a scaled carp or a scabby bream I put it in No. 16, and in a few days it is completely cured.

"There were also some chevannes in this tank, but considering the use I made of this compartment as a hospital, I thought it best to place no inscription upon it.

Tank No. 17.

"*Tank No.* 17.

"This tank, the last of the left-hand gallery when entered by the southern stairway, receives the overflow of all the compartments of this gallery; the water, therefore, is best adapted to goldfish, which seek a warm temperature. I at first intended it to receive the common bream or *Abramis brama*, a large number of which could easily have moved about in it. I do not know by what inspiration our purveyor of fish imagined that he should not find bream at Paris, and sent us about 60 of them from Switzerland, which, reaching the aquarium all scaled, and their fins fringed, immediately took the moss, and all perished in three days' time, attacked by the fungus *Saprolegnia ferox;* so we were obliged to replace them by bream caught in the Seine.

Bream.

"The tank was soon filled, and, as these fish had been taken at the spawning places, I had the satisfaction of seeing them reproduce themselves the week after their arrival. Contrary to the usual belief, the brème does not deposit its eggs upon vegetables, and does not rub itself upon solid bodies to produce laying. Like many other sea-fish which deposit their eggs in large numbers, the male and female keep on the surface of the water at spawning time, moving and rubbing themselves one against the other. They then proceed to the emission and fecundation of eggs, which burst out in all directions and are disseminated on

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Aquarium of the Trocadéro.

all sides. The spawning lasted in this way three days, the 26th, 27th, and 28th of June, during which time hundreds of thousands of eggs were emitted. I had not time to collect them, as the labor of organization absorbed every instant. Let us hope that these observations resumed at a more propitious moment may lead to unexpected and perhaps very useful discoveries.

Tank No. 18.

"*Tank No.* 18.

"Tank No. 18 begins at the extremity of the first gallery, where the water flows out from the trout compartment, that is to say, on the right of Tank No. 7; it forms the head of a line running from north to south.

Nases.

"In this tank are about 40 nases, or *Chondrostoma nasius*. This fish, which is of very bad quality, was formerly rare in the Seine, but has taken up its abode there since the junction of the Northern Canal with Holland. Its maximum weight is 1 kilogram; it feeds upon moss and confervæ, of which its flesh always tastes.

Tank No. 19.

"*Tank No.* 19.

"If there be any tank whose history is interesting to know, it is No. 19. Its exposure is full south; it receives the overflow of the preceding tank, which has already been subjected to contact with the light.

"In No. 19 vegetation is luxuriant, and so soon as the solar rays penetrate its liquid body millions of little gaseous bubbles, sent out by the mosses, rise to the surface of the water. This gas, produced by the respiration of the plant, is oxygen in its original state, separating like an almost imperceptible fog. Here is the hygienic center *par excellence*.

Experiments in raising exotic fish.

"The studies which I have had occasion to make during the past few years upon the reproduction and raising of different exotic fish have convinced me that these species cannot thrive and reproduce themselves except in water first submitted to a strong light, that is to say, to the sun's rays; and that in a shady place, penetrated by but a diffused light, they dwindle away and perish visibly. Tank No. 19 gave me the opportunity of reproducing the same phenomena, as well as of verifying their action.

Cat-fish of the Danube.

"We had previously received at the aquarium six cat-fish of the Danube, or *Silurus glanis*, some of large size, whose maximum weight was 27 kilos. Knowing that these fish fly the light of day, we placed them in the center, that is, the least lighted, tanks. A white moss formed upon their bodies in a short time, and we regretted to see them perish the same week of their arrival. The same phenomena had been produced at the Exposition of 1867, and the same in the aquarium of the Vienna Exposition; the fish always died of the same malady.

Cat-fish of Basle.

"On the 23d of July there came to us, from Basle, 34 cat-fish, one of which weighed 31 kilos. What should we do with them? We knew by experience that if we placed them where the others had been they would be condemned to a prompt and certain death.

"In a conservatory near the aquarium of Trocadéro, where I kept my own special exposition, I had collected in my aquaria 24 species of exotic fish, and some *Silurus glanis* of small dimensions. All these fish, subsisting also upon the waters of the Vanne, had appeared to suffer at first, and I was only able to keep them alive by raising the awnings which covered the roof. In spite of the diversity of habits and customs among all these creatures, from the day when I subjected the water upon which they lived to the action of the sun's light their

health remained perfect and I had no death to record. The experience was conclusive, and I did not therefore hesitate to put the 34 new silures which had just arrived in No. 19, which was in the same condition with regard to light as the aquaria of my conservatory. I had not to wait long for the result which I expected. Some of them which had been injured in the journey to Paris were restored in three or four days, and got rid of the muscosities which covered them on their arrival; the upper jaw of the large one of 31 kilos, which had been penetrated by the fish-hook, was beginning to heal, and since then I have not lost one.

Aquarium of the Trocadéro.

The silures in the light tank.

"How had the action of light brought about such a result? Wishing for an explanation, I communicated my observations to my friend Professor Gérardin, who had made a study of the different proportions of oxygen contained in different waters, and we undertook to measure the proportions contained in the waters of Trocadéro.

The lesson:

"The water of the Vanne in the aquaria of my conservatory contained when it entered there 5.2 centimeters of oxygen for every liter of water; after remaining one hour in the aquarium, under the influence of the sun's rays, the proportion of oxygen rose to 8.8 centimeters per liter.

oxygenation of the water,

"The waters of the Vanne in the large aquarium, taken from the entrance pipe, contained also 5.2 centimeters of oxygen per litre; in the lower tanks, submitted to the action of the hydraulic bellows, the proportion of oxygen rose to 5.4; and in No. 19 and the following tanks the oxygen contained in one liter of water rose to nearly 9 centimeters.

"From these experiments, renewed several times at intervals of some weeks, it results that oxygen mechanically introduced into water is little, almost not at all, soluble; whereas oxygen in its native state, that is to say, produced by the respiration of aquatic vegetables, is much more soluble, almost in double proportion. Does this mean to say that the hydraulic bellows has no effect at all upon the life of animals in the aquarium? On the contrary, every time that we put it in action we saw the fish go up near the air-jet and absorb a portion of the ascending bubbles. Moreover, it is well known that to transport some fish alive successfully it is necessary to shake the receptacle from time to time; the water is also aired by the motion of the railway. But when this water goes back into a state of repose the air-bubbles escape into the atmosphere, and the proportion of oxygen is not augmented.

introduced mechanically.

"The very important natural law which results from these observations may be expressed as follows: Oxygen in its native state, resulting from the respiration of vegetables, and especially from microscopic algæ, is very soluble in water. Atmospheric air introduced mechanically into water is not dissolved there, or, if so, in very small quantities.

and by the respiration of vegetables.

"To-day, December 15, our silures are doing very well. They live upon gudgeons, which are given to them alive. To make them live, it has sufficed to put them into water already subjected to the action of light, and therefore much oxygenized.

"*Tank No.* 20.

Tank No. 20.

"No. 20 receives the overflow of the preceding tank, and is inhabited by rapacious fish, pike, or *Esox lucius*, perches, *Perca fluviatilis* and ruff, *Acerina vulgaris*. During the heat of summer it was difficult for us to

Pike, ruff, and perch.

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Aquarium of the Trocadéro.

collect a sufficient number of these fish to fill this tank, which is very wide. During fine weather these fish in the river hide themselves among the grass and are very diffident, so that the nets of the fishermen hardly reach them; later, towards the month of October, when vegetation no longer exists, they may be caught almost anywhere.

Tank No. 21.

"*Tank No.* 21.

Breams and gudgeons.

"This tank is peopled by about a hundred white breams, *Abramis blicca*, called "*bordelières*," because they frequent by preference the borders of streams. The scales of these fish are large, and their fins edged with red. This fish produces very good effect in an aquarium; they form bands and are always in motion.

"Some gudgeons which escaped from a neighboring tank took up their abode among these breams, and, as the exposure is good and the water very well oxygenated, they reproduced themselves in abundance.

Tank No. 22.

"*Tank No.* 22.

Ides, minnows, and sticklebacks.

"This tank contains three kinds of fish: First, about 50 golden ides, or *Idus melanotus*, a sort of roach, whose body is almost as red as the gold-fish of China, the belly being of a much paler tint. The golden ides appear to be found in the neighborhood of the Lake of Constance, in Switzerland. Second, 500 minnows, *Phoxinus lævis* and, finally, a thousand sticklebacks, were put into this tank, which is very large, to give it a little animation. These latter species have reproduced themselves abundantly, but, on account of the great light, the glass became green every two or three days, and it was necessary to draw off the water quite often in order to clean it, a circumstance of which the young took advantage to escape through the pipes. A sufficient number, however, still remain, which may be known by their small size.

Tank No. 23.

"*Tank No.* 23.

Tenches.

"This tank follows the preceding one, and we have always appropriated it to tenches. Receiving the water which has passed through all the tanks of the southern portion, the mean temperature is 17° to 18° centigrade, not to be found in any other part of the establishment. Still, this was not high enough for this kind of fish, which requires water at 24°.

"The result has been that the tenches have always refused the nourishment offered them, which consisted of bread and of cakes made of crushed hempseed.

"The tench is a fish which lives at the bottom of the water and is always working in the mud. Contrary to their nature, we saw them during the whole time of the Exposition keep to the surface of the water instead of occupying the bottom of the tank. This was because the temperature of the water was warmer on the surface than below; rather than go to the bottom, which was only 14° or 15°, the fish kept on the top, where there was more heat, and died of hunger.

Tank No. 24.

"*Tank No.* 24.

Carp.

"This is the last tank, and consequently it receives all the water discharged by the right gallery. It is occupied by about 50 carp, *Cyprinus carpio*, of large size. These fish, the first introduced into the aquarium, had to undergo all the consequences of a new construction;

however, they bore it very well, and three or four only perished during the six months of the Exposition.

Aquarium of the Trocadéro.

"Frequently visitors seeing such white-looking fish thought they were sick, but it was not so. The carp has large scales, arranged like the tiles of a roof, and forming at the extremity a sort of border, which prevents any sediment from sliding freely over their surface. In touching this fish the hand feels this roughness. The water of the Vanne contains in solution a relatively large proportion of carbonate of lime; moreover, the fish in the other tanks, in seeking for food, naturally disturbed the water, and this sediment settling upon the scales of the carp gave it that unpleasant appearance. I had them washed with a sponge every week, after which, adorned with their native colors, they appeared like different creatures."

Tank No. 24.

Carp.

The carp; and the pike in European carp culture.

Carp culture.

As one variety of the fish just referred to (the carp in Tank No. 24) has been imported into the United States by the Commissioner of Fisheries, and now occupies an important place before the country, it will be well to repeat here a curious fact, related by M. Carbonnier, concerning the use of another food-fish—the pike—as practiced in European carp culture. When, in consequence of favoring conditions, the carp-ponds became filled with white fish, roach, and other small fish which multiply very rapidly, great injury is done to the carp and tench. The smaller and comparatively worthless fish absorb to a great extent the food which would otherwise be devoured by the carp, and prey upon the eggs deposited by the latter fish. It then becomes a matter of importance to the cultivator to clear the ponds as quickly as possible of the intruders, as they would otherwise, slowly but surely, take the place of the more valuable fish. In order, therefore, to accomplish the desired end, young pike are often introduced into the ponds under certain restrictions, which will now be noted. The pike possesses a most voracious appetite, and developing rapidly, in consequence, wherever it finds an abundance of food, soon matures and begins to reproduce its kind in overwhelming numbers. It is necessary on this account to be able to distinguish the sexes with facility and certainty, since, if they should be indiscriminately placed in the carp-ponds, after first destroying the small fishes which constitute their legitimate prey, they would quickly develop and multiply to an extent which would enable them to exterminate also the fish which they were intended to protect, and which were the special objects of the cultivator's care. In order to prevent such increase and consequent ravages on the part of the pike it is necessary, therefore, to place the separated sexes in ponds which afford no means of com-

Use of pike in carp ponds.

Nature and habits of the pike.

Injurious increase prevented by separation of the sexes in different ponds.

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munication; while, to determine the sexes with certainty, to insure their separation, it is only requisite to remember a few facts in reference to their relative rates of growth.

Carp culture, and the use of the pike in carp ponds.

In France the pike spawn in February, and for this purpose repair to the waters of small canals and shallow ditches, the temperature of which ranges from 10° to 12° centigrade. The young fish are hatched in from 12 to 15 days, and grow very rapidly when they begin to feed, as they soon do, most voraciously, upon insects, larvæ, and, in fact, almost any floating or moving edible object. When thus feeding they lie near the surface of the water, and in localities where other food is not sufficiently abundant they readily devour each other.

To distinguish the sexes of pike.

About a month after the young pike are hatched a very marked difference may be observed in the sizes of individuals of the same age. This disproportion in growth is attributable to the fact that the females develop much more rapidly and attain a much larger size than the males. The number of males, too, is now greatly diminished, in consequence of many of them falling a prey to the larger and stronger females of the same brood. This conduct, however, does not affect the numbers of the succeeding generation, since a single male is capable of fertilizing the eggs of a number of females. At the age of six months the latter frequently attain a length of about 11″, while the males are not yet over 5½″. By selecting the smaller fish from broods of the same age, therefore, one is certain to obtain males only, while by taking the larger ones females alone will be as certainly secured.

The relative rates of growth already remarked is continued up to five or six years of age, when the females often weigh from 20 to 25 lbs., while the males will not weigh more than half as much. Another curious and related fact mentioned by M. Corbonnier, in reference to the pike, is that the females often spawn when but a year old, while the males do not become adult until the second year.

Rapid growth of the pike, and its short life.

So rapid is the growth of this fish that they often attain a length of from 3′ to 4′ in as many years, individuals being often found in carp-ponds to weigh from 15 to 20 lbs. They are comparatively short-lived, however, and rarely pass the age of four years when confined in ponds. As an illustration of this fact, it may be observed that the cultivators seldom find a second time the large pike which have been returned to ponds that have been drawn off; it is customary with the breeders of pike, therefore, to clear their ponds once a year, and to utilize all the large fish for purposes of food on such occasions. The brevity of the life of the pike

is, indeed, an important condition of its use in carp-ponds. Though a most voracious and prolific fish, its numbers can be easily and accurately restricted if one sex only is placed in a given pond, while its brief lease of life renders its utter extermination a matter of certain and easy accomplishment whenever desirable, as in the case of ponds which cannot be readily drawn.

Carp culture, and use of pike in carp ponds.

Two remarks may be added in this general connection. The first is that the carp, for whose protection the pike are placed in the ponds, is very long-lived; and the second is that as the anatomy of the pike is such that it cannot turn readily under any circumstances, and as it chases its prey entirely by sight, dashing forward in straight lines of from 15′ to 20′ in length in the pursuit, it would never prove efficient in muddy ponds. Although the pike is much used for food, bringing about 18 cents per lb. in the markets of Paris, it should never be cultivated for this purpose, since, as asserted by M. Carbonnier, in order to attain a weight of 22 lbs. an individual of this species must have devoured 220 lbs. of other fish, the food of 200 persons for one day! At the rate of 18 cents per lb., again, a pike of the above-mentioned weight would bring about $4; but as in its lifetime it has devoured at least $20 worth of fish-flesh, it cannot be said to be a very profitable article of production.

Great expense of raising pike.

The tench.

The tench.

Having thus considered the use to which the pike may be properly devoted by the fish culturist, we may now turn to another fish, quite a number of which were exhibited from time to time in the aquaria; and which have also been imported into America by the United States Commissioner of Fisheries, viz, the common tench (*Tinca vulgaris*) of Europe. This fish is familiarly known in France as the "fish-doctor," an appellation said to have been derived from the fact that the tench are often placed in tubs with o her fish which manifest signs of sickness, whereupon the tench, occupying the bottom of the tank, force the sick fish from their state of inactivity, and compel them to circulate freely through the water, an exercise which of itself often proves beneficial. Healing properties are also attributed to the mucus which flows freely from the skin of this variety of fish.

Oxygenation of water in aquaria.

Oxygenation of water in aquaria.

The history of Tank No. 19, as given in the extract from the report of M. Carbonnier on pages 462–3, is well worthy of

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Oxygenation of water in aquaria.

special attention, since the comparative amounts of oxygen obtained by absorption from air artificially forced into the water on the one hand, or from aquatic vegetation on the other, is a matter of much interest and consequence as bearing upon the system of aquarium construction. The efficient superintendent gives a history of the methods employed by him to overcome the difficulties arising from the fact that the water which supplied the tanks was derived from near the source of the river Vanne, and had not, therefore, been subject to sufficient aeration and exposure to the sun before being used for his purposes. As they may afford an important hint to our fish culturists, and may suggest better methods than that of "piping" the water directly from springs to the hatching houses, the remarks of this careful observer are reproduced at some length:

Experiments with the waters of the Seine and of the Vanne.

"The water of the Vanne, taken almost from its source, contains consequently little air and no organic germs; hence, although very useful for the cleansing and purification of the basins, it was not suitable to favor the rapid development of a prompt cryptogamous vegetation upon the sides of the tanks. I substituted, therefore, the water of the Seine, the color of which was at that time green on account of the abundance of microscopic germs, spores of algæ, confervæ, and, in fact, all those vegetable aquatics—for the most part microscopic—the presence of which is requisite for the continuous oxygenation of water intended to receive fish. In truth, upon water as well as upon air has been imposed that great law of nature which counterbalances and equalizes the animal and the vegetable kingdoms, making one the indispensable auxiliary of the other.

"Fish, as well as animals on land, absorb oxygen by respiration, and give out carbonic acid, the quantity of which, always increasing in the place which they inhabit, would not fail to produce asphyxia if the aquatic vegetable were not present to produce a chemically inverse effect. Under the influence of solar radiation the green immerged particles absorb carbonic acid, decompose it, assimilate the carbon, and exhale the oxygen, which appears upon their surface in innumerable small bubbles, supplying the fish with the respiratory element, renewed and endowed with a vital action so much the more efficacious because just brought to life, and possessing a solubility much greater than that of oxygen drawn from the atmosphere.

"Perhaps there is even a formation of bioxide of hydrogen, which would explain this co-efficient of solubility so much greater than that admitted by chemists. However that may be, for me the fact is now incontestible that to establish in an aquarium a hygienic medium suitable for the life of aquatic animals an abundant vegetation must there be developed, which should frequently undergo the action of solar radiation. When the tanks were filled with this green and disturbed water I stopped the flow, that by stagnation the germs might become fixed upon the rocks. Towards the 10th of June this result was obtained; all the sides of the tanks were tapestried with green moss. I then drew out the water of the Seine and let in the limpid stream of the Vanne, which from this day changed the entire aspect of the aqua-

rium, to the great satisfaction of the public, who, not understanding the previous disturbance, and being able to see nothing, had spared me neither criticisms nor discouraging observations."

The fish-markets of Paris.

Fish-markets of Paris.

The whole story of the exhibit of food-fish as contained in the Exposition has now been told, but as a very large and interesting display of the same kind may be seen every morning in the Paris markets, I may be pardoned if I add a brief account of the results of inquiries and observations which I was led to prosecute in that quarter.

Fish brought alive in tanks to Paris market.

As the living fish invariably command better prices in all parts of Europe than those which die before they can be brought to market, fresh-water fish are usually brought to the principal markets, particularly that of Paris, in tanks specially designed for the purpose of keeping them alive, and are sold at auction to the highest bidder by a factor regularly appointed and licensed by the government for this purpose. When purchased by the retail dealers, the fish are carefully transferred to marble tanks, with which each stall is provided, and in these they remain exposed for sale during the day, or until sold. Should any remain on hand, however, at the close of market hours, they are transferred again to larger basins, also provided by the government, in the basement of the market-house. These basins, as well as the smaller ones in which the fish are exposed for sale, are supplied with a constant stream of running water. The factor above referred to controls all matters connected with the sales; keeps a record of the quantities sold, prices brought, etc.; collects all custom-house dues and sales commissions; and is required by law to make periodical reports to the government, to which he is required to give heavy bonds for the faithful performance of his duties.

The tanks in the stalls of fish dealers.

Tanks in the basement of the market-house.

Supplied with running water.

Salt-water fish packed in ice and moss.

Salt-water fish, which are invariably brought to market dead and packed in ice and moss, are sold under corresponding restrictions and regulations; and although the fisherman is entirely free to dispose of his fish to any merchant who may wish to purchase them, the sale must be made through the government factor, at a somewhat increased expense to the fisherman, and, in the end, to the consumer. There are many varieties of fresh-water fish which are too delicate to admit of their being kept alive for any length of time for the purposes of transportation and sale; these are sold dead, and under the same limitations as the salt-water fish.

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The principal varieties to be found alive in the market are the *Cyprinidæ* and eels, besides large numbers of crawfish, crabs, and lobsters.

Ornamental fish.

b.—Fish alive, for ornament.

M. Carbonnier.

A tasty building, very similar to an ordinary greenhouse, the private exhibit of M. Carbonnier, contained fishes bred by him to supply the public with ornamental varieties for aquaria.

In response to an expression of surprise that this exhibit consisted entirely of the ornamental kinds, M. Carbonnier made known the singular fact that although fish culture originated in France with the prime object of thoroughly restocking her depleted waters with fish suitable for purposes of food, yet that much less attention is paid to the rearing of edible than of ornamental varieties; and so decided is the preference in favor of the latter that he now devotes his energies entirely to their cultivation.

Culture of ornamental fish more popular than edible varieties.

The French, he added, are better patrons of the beautiful than of the useful.

The interesting exhibit at M. Carbonnier's private aquarium comprised the following objects:

Collection of exotic fish.

Gourami of India, produced in Paris, *Osphromenus goramy.*

Catfish of North America, *Amiurus catus*, first brood in Paris.

Rock-bass from Canada, *Ambloplites rupestris.*

Mummichog of North America, *Fundulus majalis*, fourth generation produced in Paris.

Transparent-fish of Bengal, *Ambassis.*

Macropodus of Cochin China, *Macropodus viridi-auratus*, eighth generation produced in Paris.

Kin-yu of Japan.

Catfish of the Danube, *Silurus glanis.*

Proteus, Grotto of Carmile, Austria.

Ombre of Turkey, *Umbra Crameri.*

Climbing fish of the Ganges, *Anabas scandens.*

Callichthys of Brazil.

Doras of Buenos Ayres.

Loach, *Cobitis fossilis*, from the north of Europe.

Telescope-fish, *Cyprinus macrophthalmus*, from China and Japan, third generation obtained in Paris.

Some other and minor exhibits by other individuals consisted entirely of the common goldfish, and do not require more particular mention.

Gourami.

The gourami.

Specimens of the *gourami* in M. Carbonnier's collection were hatched in Paris, and were the eighth generation from

a colony imported from India. Although it is much esteemed in the East as a food-fish, and is reported by those who have eaten it to be of most exquisite flavor, those contained in this collection could not be considered otherwise than as purely ornamental. In its native waters the *gourami* frequently attains a length of 2′, but those bred in the small aquaria did not exceed 4″ or 5″.

Exotic fish.

Gourami.

In a very interesting article published in the second volume of the report of the United States Fish Commissioner for the years 1872 and 1873, Professor Gill cites an instance of this fish having attained a length of 5′ or 6′, and a weight of somewhat over 110 lbs. The same author states that the fry are about half an inch in length when hatched, and about 4″ at the end of the first year, but that after that period the increase in size is very gradual. The time of reproduction is generally about the third year. Their growth, though exceedingly slow, as stated, must be continued for a corresponding length of time, and the specimens mentioned by Professor Gill had probably reached an advanced age, while those bred in the comparatively cold waters of the latitude of Paris were, doubtless, undersized. The Prince of Wales' collection contained a very fine specimen which measured about 20″ in length by 12″ in depth.

Professor Gill.

As this fish will soon be imported by the United States Fish Commissioner, to supply the long-felt need of a vegetable-eating fish for our more southern waters, Professor Gill's article contained in the above-mentioned report will no doubt be perused with interest.

The macropodus.

Macropodus.

The most interesting tanks in this collection were those devoted to the macropod.

As the breeding season occurred during the period of the Exposition, the curious habits of this fish were fully illustrated by the couples there exhibited. These were of the eighth generation from an importation received by M. Carbonnier on the 8th of July, 1872. The dorsal and anal fins are very long, and tinted with the most brilliant colors. The scales, representing in themselves all the colors of the rainbow, display vertical bands in yellow, red, and blue, intersected by stripes of changing color running from the head to the tail. Its vivid coloring, graceful, gently rounded form, and peculiarly shaped tail, which is long, forked, and wide-spread like that of a strutting peacock,

Peculiar habits.

Brilliant colors.

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Exotic fish.

Macropod.

Beautiful colors.

have secured for it the name of the "paradise fish," and in respect of beauty of appearance it is indeed among fish what the bird of paradise is among the feathered tribes. Beauty of form and color, however, does not constitute its sole attraction, since nothing could be more pleasing or entertaining than to observe the movements as well of the parent fish as of their diminutive progeny.

Peculiar habits at spawning.

When approaching the spawning season the edges of the fins of the male assume a bluish and the entire ventral fin a saffron-yellow hue. The males now strut about with great vivacity, like peacocks or turkey gobblers, or make occasional sudden leaps, which display their brilliant colors with fine effect, to attract the attention of the females, and when this object is accomplished begin to dispute with each other for their possession. The intelligent culturist invariably separates the fish at this period, placing two males with one female in each tank. The female is thus incited to greater activity, while the males enter upon determined contests, the victor in which is always allowed to remain with the female, as it is thought that a more vigorous and in every respect superior progeny results from a selection thus determined.

Duties of the male in the rearing of the young.

The male fish performs more than the ordinary duties of a father, since he takes upon himself an unusual and very important part in the rearing of the young. When the female is about to deposit her eggs he places himself against the glass of the aquarium, and absorbing atmospheric air at the surface of the water, expels it again in the shape of innumerable bubbles, which coalesce to form a frothy ceiling that floats upon the water, where it remains intact. The substance of the froth so produced is probably a fatty mucus secreted in the mouth of the male.

The frothy nest.

The frothy nest having been fully prepared, the male dilates his fins and bends himself into the form of a bow, when the female approaches and, assuming a vertical position, with her head near the surface of the water, by a peculiar oscillating motion places her body within the semicircle formed by that of her companion. The latter, by bending and contracting his long fins, which play gently upon her sides, now causes her to slowly revolve; all of which movements are very graceful and quite conspicuous on account of the brilliant coloring of the fishes.

The pair while in this position allow themselves to fall through the water from the surface to a depth of 6″ or 8″, and this movement is repeated every 10 or 15 minutes. During the intervals the male continues his work upon

Exotic fish.

Macropod.

Spawning.

Care of the nest by the male.

the ceiling of froth, which, at the time they commence to spawn, occupies a space of about 15 square inches, and is about one-third of an inch in thickness. Almost all of the eggs are fecundated, since the juxtaposition of the male and female causes the spermatozoa and eggs to come into contact very readily, quickly, and certainly. As soon as they are laid, the male takes them in his mouth and places them in the nest of froth, and when the spawning is completed drives the female from the neighborhood of the nest to a distant spot, where she remains exhausted and motionless, while he assumes the entire care of the eggs. Whenever a break occurs in the nest and any of the eggs escape, the male immediately seizes them in his mouth and replaces them, repairing the nest by fresh bubbles of foam, and working very dexterously with his head in filling up the breaches. The eggs are transparent on one side, and in water of the temperature of 20° to 22° centigrade hatch in about sixty-five hours. A like additional period is required for the absorption of the umbilical sack. During all this time the male is constant and lavish in the care which he bestows upon the eggs and young fish, the latter being frequently taken into the mouth of the parent fish and then rolled about, for a purpose which, perhaps, is not fully understood. It has been observed, however, that this peculiar treatment is very essential to the welfare of the young fish, since those which were removed to tanks to which the male fish had no access soon sickened and died, in consequence, apparently, of a sediment of dust collecting upon their gills, whereas there was but very slight mortality among those which were left to the fostering care of the parent and subjected to the treatment mentioned.

Care of the young fish.

The male pursues the young fish which escape from the nest, takes them into his mouth, and carries them back to the protecting cover. When they escape in considerable numbers he catches and transports in this manner as many as ten or a dozen at one time.

When the fish have attained a considerable growth, however, and begin to annoy the watchful parent by their frequent escapes, he learns that they are able to take care of themselves and ceases to capture them. It is a peculiarity of this fish that spawning is repeated quite frequently after intervals of seven or eight days.

Food for young fish in aquaria.

Food for young fish in aquaria.

The healthful appearance of all the fish exhibited was a matter of general surprise, and was due, doubtless, to the

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care with which they were fed and to the peculiar food used.

Food for young fish in aquaria.

The exceeding difficulty of rearing the minute young of the macropod and kindred species early presented itself to M.

M. Carbonnier.

Carbonnier, and led him to produce larval food in large

Larval food.

quantities by artificial means. When we take into consideration the fact that the young fish are not more than one-fifth of an inch in length when the sack is absorbed and they first require to be fed, the difficulties to be encountered in their artificial propagation become very apparent. Having first ascertained what was their proper food, he found it necessary to separate the different broods, as it was observed that the larger fry greedily devoured each succeeding generation. The exceeding fertility of this fish, indeed, is doubtless a means specially provided for the sustenance of the earlier broods. It having been observed that the organic substances which settled at the bottom of the tanks and commenced to decay soon gave rise to various infusoria, which, swimming to the surface, were there eagerly devoured by the young fish, attention was speedily directed to the artificial production of this new kind of food.

Fermentation of a paste to produce infusoria.

M. Carbonnier attributes the success presently attained in this direction to the valuable advice given by Prof. Paul Gervais, following which he fermented a decoction of hay, lettuce, paste, and animal matter, with the desired results.

A still larger measure of success was obtained, however, from the fermentation of roots and stems of aquatic plants, which had been first cut into very small pieces. From this

Animalculæ from the fermentation of chopped roots.

matter he produced four or five millions of animalculæ, which were next separated from the fermented liquor by means of filters that allowed the fluid to pass through, but retained the animalculæ upon their surfaces. The latter were next assorted by means of three graduated sieves, in order to their proper distribution among the young fry of the different broods.

The problem as to what constitutes the proper food of fish artificially raised in small tanks is a most important one, and one that presents many serious difficulties to the con-

Selection of food for certain fish.

sideration of the fish culturist. It is no doubt true, indeed, that the conspicuous failures of many fish-cultural establishments in America is attributable to the improper nature or quality of the food given to the fish in the early stages of their existence, and a study of the methods employed by M. Carbonnier becomes, on that account, a matter of consequence to all who are interested in the subject.

The outer leaves of the lettuce are particularly recommended as an element for the production of the monads,

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which are probably the first natural food of young fishes. The problem as to the transportation of shad across the Atlantic, which has been several times unsuccessfully attempted, may yet be solved by the use of these methods; and the rearing of whitefish and other varieties which has baffled the endeavors of our fish culturists heretofore may also be accomplished by following the example of the French. When the most critical period, *i. e.*, that immediately succeeding the absorption of the umbilical sack, has passed, it is generally necessary to provide suitable food for the young fish. In American establishments finely chopped meat and liver constitute almost the sole dependence for this purpose, but it was observed at the Exposition that the larvæ procurable in such abundance from stagnant pools in the immediate neighborhood of Paris were exclusively supplied to the young fish at this stage. It was further remarkable that this plan of feeding young fish upon such larval food was also followed by the English, Mr. Frank Buckland using it almost entirely for the fish reared under his direction in and about London.

Food for young fish in aquaria.

American and French practices.

The English method.

Frank Buckland.

Quite a thriving trade is driven in both London and Paris by those who devote their time to the collection and sale of this particular food. The mud-banks exposed by each receding tide in the Thames abound in such creatures, which are industriously gathered and sold by the quart in London to fish culturists. All the inhabitants of such stagnant pools and muddy bottoms cannot be used to advantage, however, since certain kinds very destructive to the life of the young fish are often found commingled with those which constitute their proper and most desirable food. Some knowledge and experience is required, therefore, to enable the fish culturist to distinguish between injurious and beneficial kinds everywhere, since in different localities and varying climates very extensive and important differences in the range of these minute and innumerable forms of life will be found to exist. Such knowledge and experience must now be acquired by each culturist from a careful examination of the fauna of his special locality, but the naturalist who has made or who would make the subject a special study, and certainly and clearly determine and point out what particular kinds and species of such animalculæ are wholesome or innocuous, and what others are either unwholesome or positively destructive, would render a signal service not only to the fish culturist, but to all who are interested upon any account in the successful cultivation of fish.

Collection of larval food on the banks of tidal rivers.

Although the macropod has been classed among the orna-

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mental fishes, M. Carbonnier declares that it may yet occupy an important place as a food-fish, since, though comparatively small, the whole posterior portion of the body is quite fleshy and of fine flavor. It would be difficult, however, to persuade any one but a Frenchman that so small a fish could ever occupy an important place in the resources of a nation as an article of food.

Food for young fish in aquaria.

Macropod.

Long-tsing-ya.

The long-tsing-ya.

Another fish of surpassing interest exhibited by M. Carbonnier was the *long-tsing-ya* or telescope-fish, of China. Its form is exceedingly abnormal, and is well portrayed in many Chinese pictures. Both the caudal and anal fins are double, and the eyes project from half an inch to an inch from the head. Those on exhibition were the third generation of an importation from China, but by means of careful selection the deformities and peculiarities which characterize the species had been maintained. The globular form of the fish renders its equilibrium very unstable, and it swims with great difficulty.

Peculiarities.

While other members of the golden carp family rub lightly against aquatic plants for the purpose of expelling their eggs, the telescope-fish requires a spawning place furnished with stiff twigs to assist it in effecting this object. The female, besides rubbing herself against such twigs as offer considerable resistance, is aided in her efforts by the male, who pushes her with his head, and so jostles her that she is frequently turned over and over in the process. The period required to perfect the eggs of this variety is somewhat longer than for those of the macropod. The fish, however, swim about actively at the age of 15 days. Another variety of this family having a double and long, feathered tail was also exhibited, and is most prized in Japan.

Habits in spawning.

Climbing fish.

The climbing fish.

Still another very curious fish exhibited in this collection was the climbing fish of the Ganges (*Anabas scandens*), imported from Calcutta in 1874. Although it is said to be consumed in large quantities by the upper classes in India, it has never been strictly considered as a food-fish, while its curious habits and form make it very interesting as an ornamental one. The peculiar structure of the pharynx of the *Anabas* enables it to live out of water for a considerable time, in localities or under circumstances where even a slight degree of moisture is present, but on the other hand it dies

very quickly when deprived of free access to atmospheric air, to obtain which it darts upward and protrudes its head above the surface of the water at short intervals. M. Carbonnier describes somewhat in detail the remarkable faculty possessed by this fish (to which it owes its distinctive appellation) of climbing the trunks of trees, which it often does to a height of 5′ or 6′ above the water, in search of food. Good specimens of the fish are frequently found upon the broad leaves of the palm tree. The same faculty is also often utilized by the fish for the purpose of migrating overland from places where food and water may have become exhausted to other and better feeding-grounds in the neighborhood, while its capacity of living out of water enables it to continue to exist imbedded in the muddy bottoms of drying ponds as long as a moderate amount of moisture remains.

The climbing fish.

Habits.

B.—Fish products prepared for food.

Fish products prepared as food.

a.—Fresh fish.

No exhibit was made of distinctively European food-fish in a fresh or recently captured state. The absence of such specimens was probably owing to the limited use of ice in Europe, and to the custom, already referred to, of exposing fresh-water fish for sale alive; the deficiency, however occasioned, being supplied, to a considerable extent, by the excellent and well-stocked fish-markets of the neighboring city of Paris. In these markets the demand for certain fish which are entirely unused in America was quite noticeable; the ray, for instance, finding prompt sale at from 60 to 75 centimes per kilo, while sea-eels, which are seldom found in our markets, commanded 1 fr. per kilo quite as readily. Most of these and other salt-water fishes are brought to market in wicker baskets, and are packed in grass, or occasionally in ice.

Fresh fish.

b.—Fish salted, pickled, smoked, and dried.

Salted fish.

Fish prepared as above indicated were very fully represented in the exhibits of several nations, the kind used being for the most part hake, haddock, halibut, herring, mackerel, pollock, and salmon.

Finland, France and her provinces, Great Britain, the Netherlands, and Norway were the principal exhibitors in this department, while the absence of any exhibit from the United States of such articles was somewhat compensated

Salted fish exhibitors.

by the display of hermetically sealed preparations shown in another quarter.

Norwegian exhibits specially attractive.

The fullest and most complete exhibit was made by Norway, a special annex-building having been required for the accommodation and display of her fishery apparatus and fish products, almost every variety of notable fish to be found on her coast, including the cod, haddock, ling, and husk, being represented in the exhibition by specimens in a dried, smoked, salted, or other form of preparation. These specimens were all admirable, and the retention of their good qualities throughout the summer showed the excellence of the methods employed for their preservation. Of the dried specimens which are designed for transportation to distant markets, those cured in salt were put up in a variety of forms, and were all of excellent quality, the cod being particularly well prepared; while herring—smoked, dried, and salted—and salmon were exhibited in large quantities, and deserve favorable mention. Quite a unique

Fish meal.

display was that of "fish-meal," which, when made into cakes or biscuits, was found to be very palatable and good food. In the preparation of this product many parts of the fish are utilized, and the bulk is greatly reduced. Norwe-

Caviare.

gian *caviare* is made from the roe of the salmon, while that of the cod is exported in large quantities to France, where it is extensively used as bait in the sardine fisheries.

M. Friele.

A translation of M. Friele's* account of the cod, herring, mackerel, lobster, whale, seal, and salmon fisheries of Norway, giving an extended description of the fisheries themselves, the methods of capture and the system pursued in preparing the products for market, can be found in the report of the United States Commission on Fish and Fisheries, vol. v, pp 707, *et seq.*

Canned fish in oil.

c.—Preserved in oil and hermetically sealed.

The southern European countries—notably France, Italy, Portugal, and Spain—contributed the largest and most complete exhibit of preparations of this class.

The abundance and cheapness of oil in Spain enables her to preserve large quantities of the products of her waters by its use. The higher grades of canned goods of this description, prepared with a special view to exportation, were remarkably fine. France, also, sustained her reputation in the matter of alimentary preparations by the exhibit made

* Notices sur les Pêcheries de la Norwège. Impression à part du catalogue spécial de la Norwège à l'exposition universelle de 1878 à Paris. Translated by J. Paul Wilson.

by her of fish preserved in oil or hermetically sealed, the excellence of her "sardines" having been generally conceded. Canned fish.

The principal fish preparation exhibited by Russia was isinglass, a very important product manufactured from certain parts of the sturgeon.

Caviare, the valuable product manufactured from the roe of this fish, was unfortunately not to be found. Caviare.

The only exhibits made by the United States in this department consisted of canned fish of various kinds, which, however, well displayed the high standard of excellence attained in the development of this comparatively new industry.

Implements for capture.

C.—Implements for capture.

a.—Stationary apparatus, weirs, haul-seines, trawls, purse-nets, floating gill-nets, etc.

Stationary apparatus.

The implements used for the capture of fish on a large scale were not very extensively represented in the Exposition. There was, indeed, nothing calculated to attract special attention, nor any devices with which American fishermen are not already familiar. Some French exhibitors illustrated

Trawls.

the form and manner of using the trawl-net, which is extensively employed on the coast for the capture of fish frequenting the sea-bottoms; and the time is not far distant when this mode of fishing will be adopted in American waters, for the purpose of capturing the many varieties of flounders which exist in considerable abundance on our coast, but are now rarely, if ever, found in our principal markets. This instrument has been so fully described in the United States Fish Commission reports, as well as in those of the dredging operations of the United States steamer Blake, that a minute description is not here deemed necessary. Drawings of the

Madraque of the Mediterranean.

"madraque," which is used principally on the coasts of the Mediterranean for the capture of mackerel—particularly the

Plates VI, VII.

Spanish mackerel—are here given (Plates VI and VII).

In the exhibit of Finland the use of pine floats on the cork lines of their seines was the most marked feature, and in that of Holland the use of iron chains for the lead lines on haul-nets was also noted as unusual. Denmark, France and her

Seines and nets.

dependencies, Japan, Norway, Russia, and Uruguay exhibited many forms of dip nets, of good and strong texture, the display from Norway being by far the largest and most complete. The use of gill-nets for the capture of cod deserves the attention of our fishermen, as much larger catches can be made, and with less exposure, by this means than by

Norwegian gill-nets.

the use of trawl and hand-line. The gill-nets used by the Norwegian fishermen are generally provided with glass floats, as in some portions of the coasts wood is scarce and much more expensive. The wood, however, serves better when the nets are used at great depths, as the pressure of the water often causes the floats to be filled, when they become useless, and are called "*drunken*" by the fishermen. The nets are put out in the evening and taken up in the morning, whenever the weather will permit. The nets are

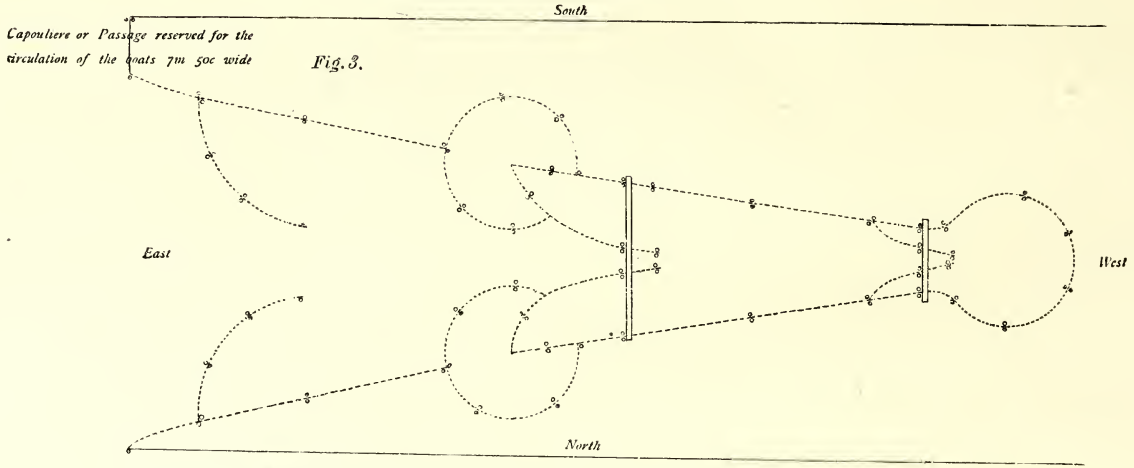

PLATE VI.—*Madraque used in the Mediterranean in the mackerel and Spanish mackerel fisheries.*

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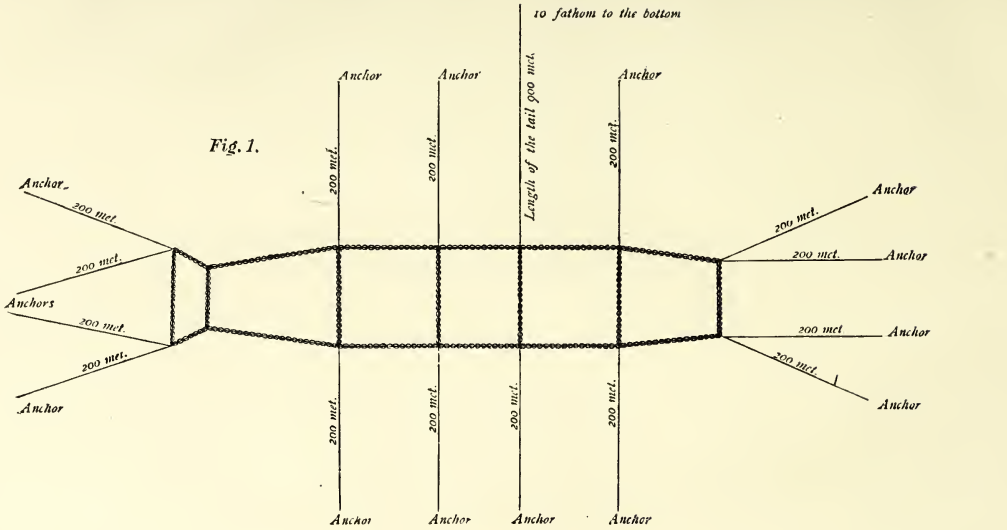

PLATE VII.—*Madrague used in the Mediterranean in the mackerel and Spanish mackerel fisheries.*

[Page 480.]

arranged so that they can be set either at the bottom or surface, or any intermediate depths, according to the habits of the fish at the particular time and locality when they are used, the fishermen readily ascertaining the depths at which the fish are to be found. The nets are always set either with the current or diagonally across it—never against it. Norwegian gill-nets.

The system pursued by the Norwegian fishermen was further illustrated by an exhibit of models of their boats. Models of boats.

The artificial propagation of the cod, which has been commenced by Prof. S. F. Baird, the Commissioner of Fisheries of the United States, may be the means of producing a breed of cod which will keep more in-shore and frequent our entire sea-coast north of Hatteras. Prof. S. F. Baird.

The success which the Commissioner very confidently anticipates will probably change, to a great extent, the character of our cod-fisheries from the use of large vessels, which are intended to brave the dangers of the banks, to that of smaller craft, for the purpose of taking the cod off-shore, similar to the system pursued by the Norwegians on their coasts. Drawings and descriptions of the most approved craft are given, in the hope that our fishermen may be enabled to derive some valuable hints from their consideration. Home cod-fisheries.

b. Angling implements, hooks, lines, etc. Angling implements.

The representation in this department was by no means exhaustive, although small exhibits of fishing tackle were made by nearly all nations. That of the English manufacturers of fine tackle, the general exhibit of angling implements by Japan, together with tackle presented by several French makers, were the most conspicuous. The excellence of the gut made by the French manufacturers was conceded. A few ingenious contrivances for keeping bait were also included in the French collections. The exhibit of hooks, lines, and tackle generally contained nothing of special interest with which American sportsmen and dealers have not been made familiar by the American Centennial Exhibition.

Vessel for transport of fish. Plate VIII.

Bateau de transport de Nordland.—This character of vessel (shown in Plate VIII) is used in carrying the products of the Nordlands fisheries (dry cod, cod-liver oil, but not much salted fish) south to the city of Bergen, whence they are exported to the markets of Europe, America, and China.

These vessels sail along the coast for about 180 geographical miles (16° latitude). It is said that the shape and rigging of this kind of vessel have been almost unaltered for centuries, and that in a vessel similar to this the Norsemen, 1,000 years ago, came over to America, or to that portion of it which they called Vineland. The black pieces represented in the upper corners of the square-sails are emblems of mourning for the famous poet and priest Peter Doss, who lived and died in Norway 100 years ago.

Peter Doss.

This vessel has no fast deck, but has aprons reaching to the middle of the mast with which to cover the fish cargo. It will sail with the wind at a speed of 8 or 9 knots. Its size is about 22 meters long, the beam 8.2 meters, the depth of the hold 3.5 meters, and with a tonnage of 80 hectoliters.

PLATE VIII.—*Norwegian vessel for transporting fish.*

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Cod-fishery row-boats. Plate IX.

Bateau de pêche au filet à douze avirons de Nordland.—This boat (shown in Plate IX) is used for operating the gill-nets in taking cod. It is quite easy to row, sails well, and is admirably adapted to this kind of cod-fishing. Like all Norwegian fishing boats, it can be easily turned over by the feet of the crew. This is done when the crew are afraid of being wrecked in rough weather. The crew are very expert in turning the boat over, so that the keel will be up.

Capsizing.

This is done to enable them to place themselves on the keel of the boat. In the bottom of the boat they then cut a hole, through which the air beneath escapes, thus rendering it steadier on the swell of the waves. In this situation the crew will wait in hope of being saved by some other vessel —a hope which is not always realized, as the yearly loss of lives in this part of Norway by boats being wrecked is about 180. Quite as many lives, however, are annually saved by being rescued from the keels of boats thus upturned. A good boat, according to Norwegian ideas, must be so built as to be easily turned over.

The sail must be shortened from below, piece by piece being taken away as the gale increases.

This character of boat is generally about 12.5 meters long, 2.9 meters beam, and from 0.9 to 1 meter in depth. Its carrying capacity is about 28 hectoliters.

PLATE IX.—*Twelve-oared fishing boat of Norway.*

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Cod and herring fishery boat. Plates X, XI.

Bateau de pêche au filet de Söndre.—This boat (Plates X, XI), which is somewhat similar to the last, is used in the herring as well as in the cod fisheries. It sails well, especially with the wind from 6 to 9 points from ahead, but is rather difficult to row. It is peculiarly constructed in the manner of joining its boards. The joints are close together, a fact which apparently weakens it, but in reality renders it more elastic and better fitted for working in rough seas.

The sail, which is single and somewhat peculiar, has the appearance of a square-sail and stay-sail combined. It is peculiar to this character of boat.

The usual size of this vessel is 12.5 meters in length, 2.8 meters in beam, and about 3 meters in depth, with a carrying capacity of about 35 hectoliters.

PLATE X.—*Cod and herring fishing boat of Norway.*

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PLATE XI.—*Cod and herring fishing boat of Norway.*

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Fishing sloop of Aalesund. Plate XII.

Sloop de pêche.—This craft (Plate XII) is used for cod-fishing on the banks of Aalesund, near Cape Stat, on the Norwegian coast. During the last few years many Swedish sloops, and some French vessels, have frequented these grounds.

Its usual size is about 18.8 meters long, 5.6 meters beam, 2.5 meters deep, with a carrying capacity of about 140 hectoliters.

Tenders.

Fig. 3 shows one- and two-masted crafts used on the same banks, ordinarily accompanying the fishing-sloop, Plate XII.

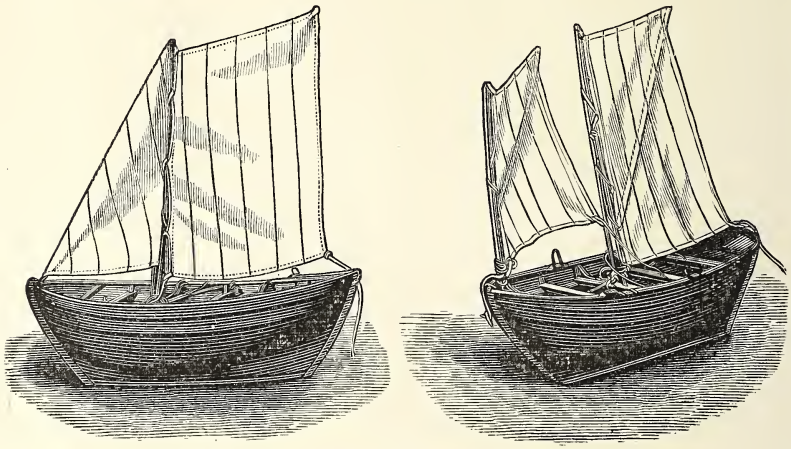

FIG. 3 —*Fishing smacks of Aalesund.*

PLATE XII.—*Norwegian fishing sloop.*

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Herring-boat of Lundfiord. Plate XIII.

Bateau de pêche au filet de Lundfiord.—This vessel (Plate XIII) is peculiar to Lundfiord, which is between Cape Stat and Bergen. It is used in the herring-fisheries, and is about 9.4 meters long, 2.4 meters broad, and 0.8 meter deep; with a carrying capacity of about 17.5 hectoliters.

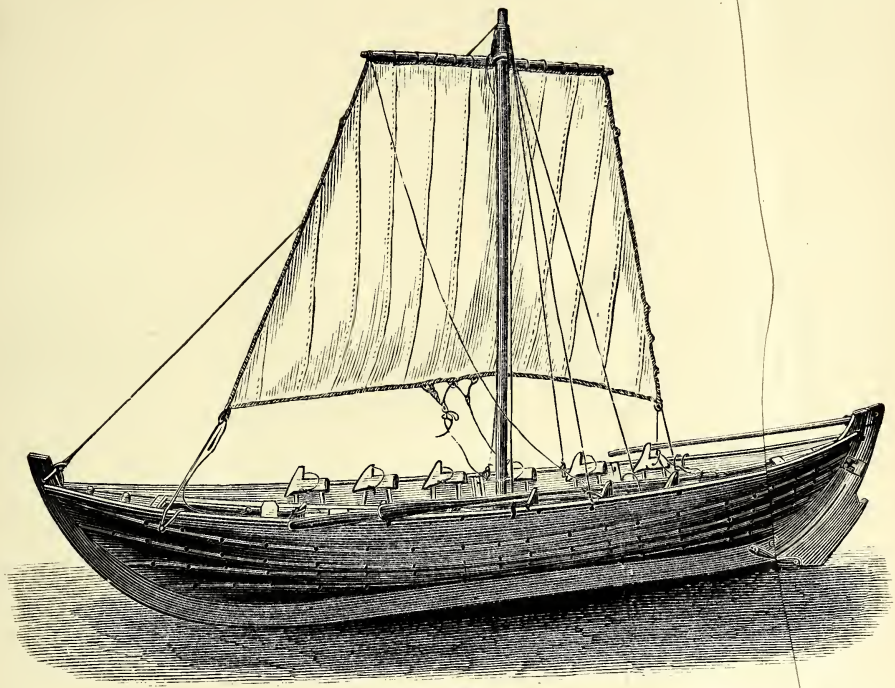

PLATE XIII.—*Herring fishing boat of Lurlfiord.*

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Seine-boat. Plate XIV.

Bateau de pêche à la seine (*filet de barrage*) (Plate XIV).—This boat is used for transporting, as well as taking, herring, by means of seines that are set across the mouths or entrances of the bays or drawn ashore on the coast. The same kind of boat is used at Ostero and Oss, which places are near the city of Bergen. The boats, however, that are used in the neighborhood of Oss are shorter, broader, and clumsier than the boats employed by the inhabitants of Ostero.

The boats of Oss are usually of the following proportions: 6.3 meters long, 1.9 meters beam, about 0.6 meter deep, with a carrying capacity of about 28 hectoliters. Those of Ostero are somewhat longer, with the same beam.

PLATE XIV.—*Norwegian seine-fishing boat.*

[Page 492.]

Police boat. Plate XV.

Garde-pêche (Plate XV).—The Norwegian Government, for the purpose of protecting the fisheries along the shore and at sea, send to the fishing districts a number of vessels commanded by officers of the navy, and it is the duty of this police force to send daily telegrams to the cities and most important points of the fish trade, in order to inform the merchants of the result of the catch and the prospects for the season.

The boats used for the purpose above indicated are of various sizes. The one represented in the cut is about 18.8 meters long, 6.3 meters broad, and 2.5 meters deep, with a carrying capacity of about 20 tons.

The use made by the Norwegian Government of these boats is well worthy of imitation by our own government. Many hundreds of thousands of dollars would be saved annually if we had an established system of sending full and accurate reports to those engaged in the menhaden and mackerel fisheries along our coasts, with correct bulletins of the localities where these fish make their appearance.

PLATE XV.—*Police sloop for the fishing grounds.*

[Page 494.]

Police boat. Plate XVI.

Plate XVI is another form of the police-sloop just mentioned, but somewhat smaller. This cut represents a boat about 10 meters long, 3.7 meters broad, and 0.6 meter deep; burden from 6 to 7 tons.

PLATE XVI.—*Fishery police sloop.*

[Page 496.]

Seine boat of Hardanger. Plate XVII.

Bateau de pêche à la seine (filet de barrage) de Hardanger.—Plate XVII is a representation of a vessel used in the herring-fishery in a manner similar to that described on page 492.

This vessel, as will be observed, has a singular shaped stern. The roller used for operating the seine is placed on the stern, instead of on the side, as in those on pages 486, 490, and 492. The apron is used in this vessel to cover the hold, in lieu of a deck.

This vessel is generally about 10.7 meters long, 3.1 meters broad, and 1.1 meters deep, with a carrying capacity of about 49 hectoliters. Like most of those operated south of Bergen, it uses stay-sails but not square-sails.

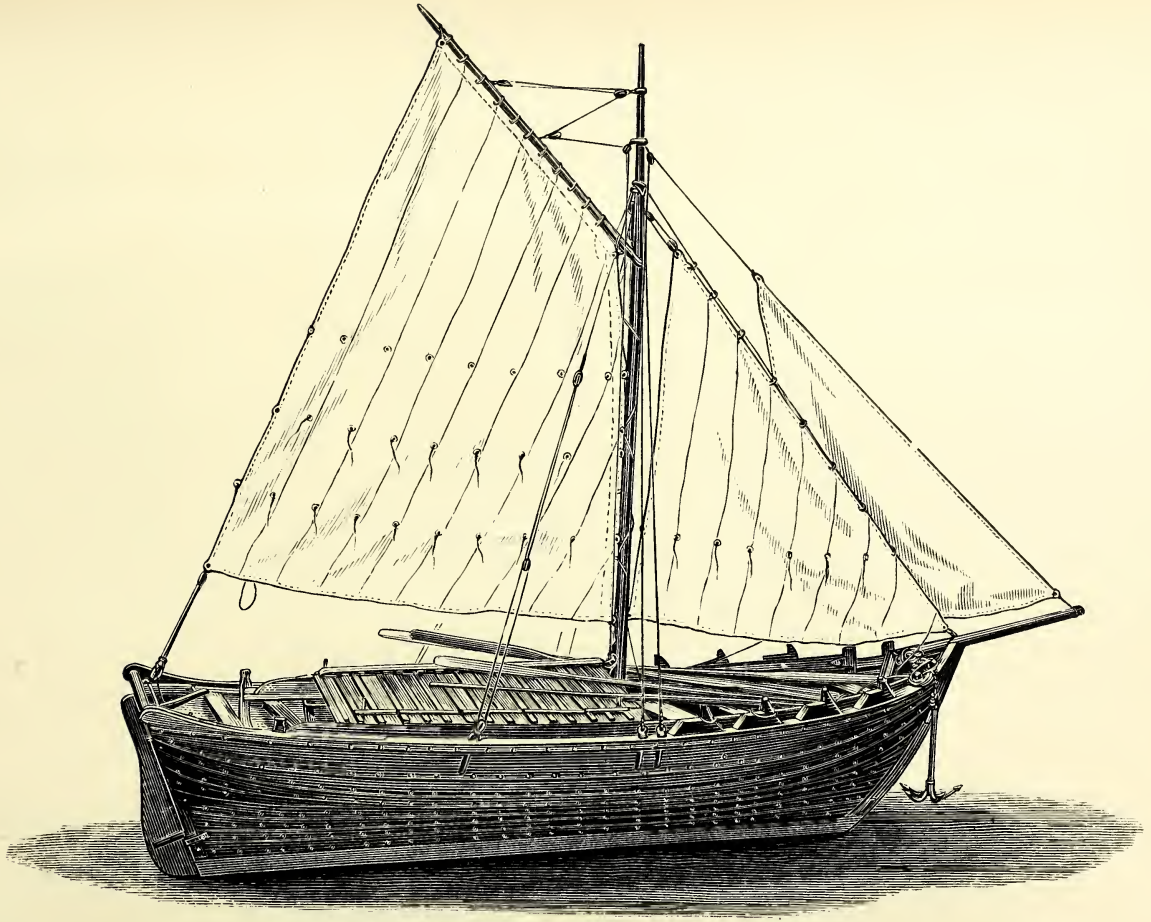


PLATE XVII.—*Seine-fishing boat of Hardanger.* [Page 498.]

Gill-net fishing-boat of Hardanger. Plate XVIII.

Bateau de pêche au filet de Hardanger.—Plate XVIII is another boat rigged with stay-sails, and is used in taking herring by means of gill-nets. It is light, but solidly built. The boat-builders of Hardanger are noted for being exceedingly clever in their business. The people of this town are generally more intelligent than the peasantry of any other part of the country. They are smart as business men, honest and brave as farmers and seamen. Both men and women are well educated.

The usual size of this boat is 7.8 meters long, 2.7 meters broad, about 1 meter deep, with a carrying capacity of about 21 hectoliters.

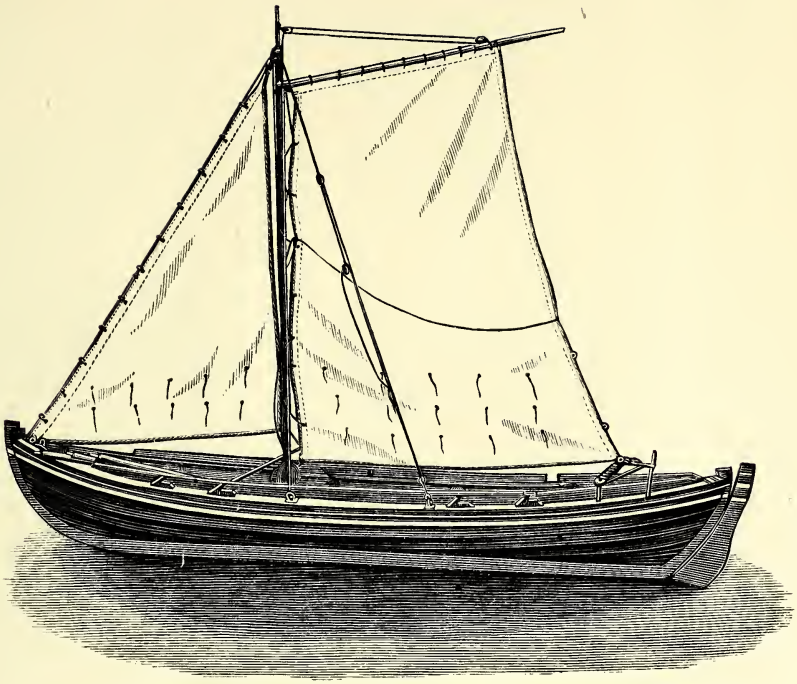


PLATE XVIII.—*Gill-net fishing boat of Hardanger.*

[Page 500.]

Fishing-boats of Lister Plates XIX, XX.

Bateau de Lister, *Listerband*.—This boat (Plates XIX, XX), which is considered the best model of the Norwegian fishing boat, is used by the inhabitants of Lister, a town near Christiansand, a little west of Cape Naze.

It is well adapted to the mackerel and herring fisheries on the coast. It is not only a good sailer, being extremely swift, but will stand a rough sea and gale very well. In calm weather it is easily propelled with oars, and this fact renders it superior to most other fishing boats.

The royal government has made repeated efforts to introduce it for codfishing at Loffoden, but in vain, as the people of that place prefer a boat which has lower gunwales, and can be easily turned over with the feet. The Lister boat is not thus easily managed. The size of this vessel is about 10 meters long, 3.1 meters broad, 1.3 meters deep, with a carrying capacity of about 42 hectoliters.

This kind of vessel is used by the pilots off Lister.

PLATE XIX.—*Mackerel and herring boat of Lister, Norway.*

[Page 502.]

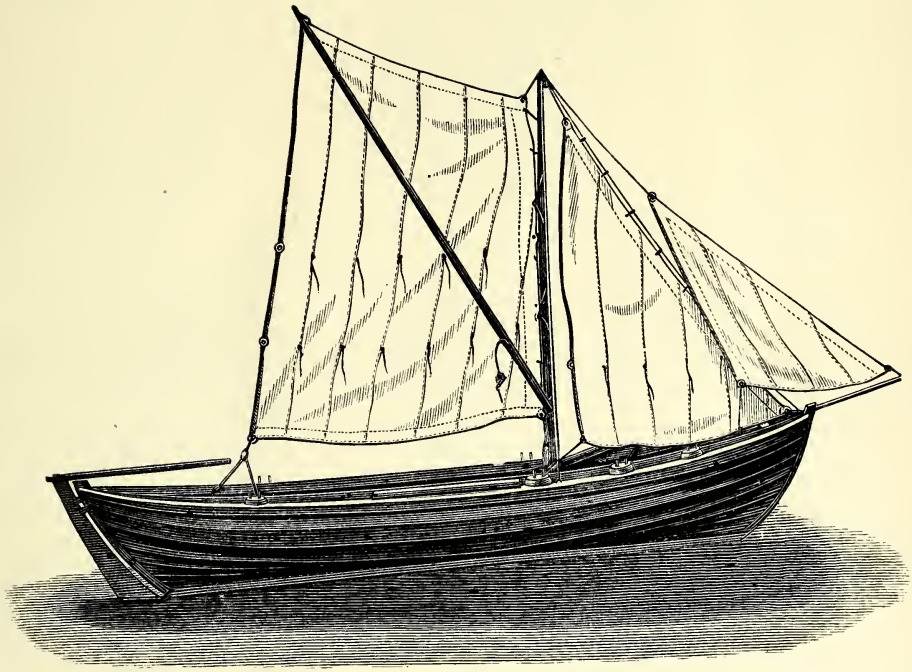


PLATE XX.—*Fishing boat of Lister, Norway.*

[Page 502.]

Four-oared fishing-boat, Faeruyband. Plate XXI.

Bateau à quatre avirons, Faeruyband.—The four-oared fishing boat (Plate XXI) is in daily use on the western coast of Norway, from Bergen southward to the Naze. This portion of country is so cut up by the fiords, which go far inland, that a boat of this character is an absolute necessity. The poorest people—even beggars—possess such boats in this part of Norway.

The boat is very light and easy to row, and can be used with either a square-sail or a small stay-sail. It will stand a rough sea better perhaps than any other model of small boat. The pilot, accompanied by his little boy or girl, in this boat will meet a vessel miles off the coast in a gale of wind.

The size is about 6.3 meters long, 1.7 meters broad, and 0.6 meters deep. In many cases only three boards, from the keel to the gunwale, are needed in its construction.

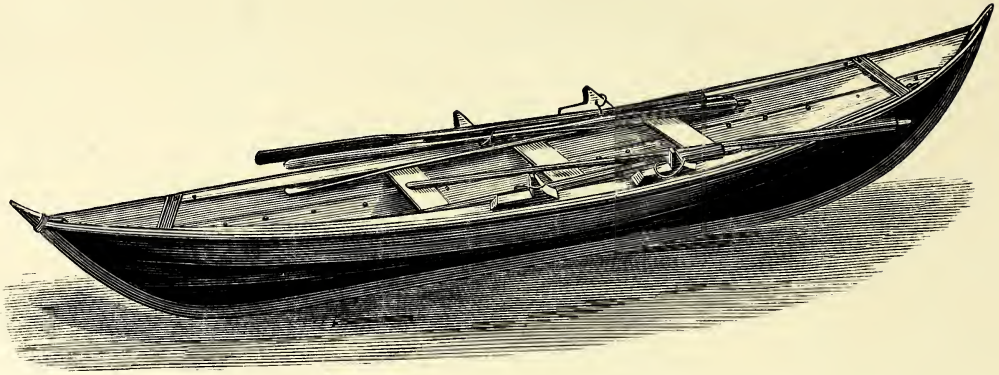
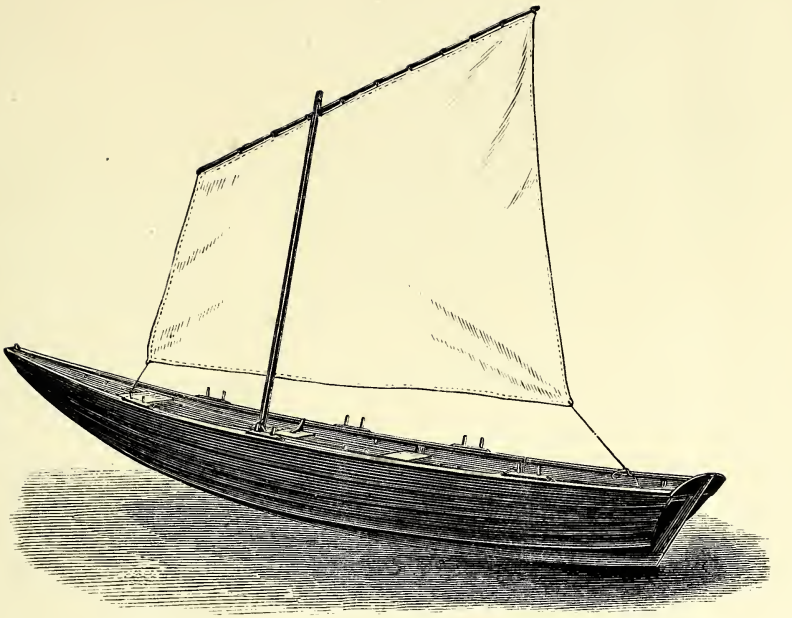


PLATE XXI.—*Four-oared fishing boat of Norway.*

[Page 504.]

Praam.
Plate XXII.

Praam (Plate XXII).—This is a small vessel used for a similar purpose on the eastern coast of Norway. It is not, however, very common, as the eastern coast is much less indented with fiords than the western, and, consequently, there is less necessity for the use of boats. It is rarely found on the western coast, and indeed would not answer any purpose there. It is very light, but lacks steadiness, and must be managed with great care. Its size is generally 5.3 meters long, 1.6 meters broad, and 0.5 meters deep.



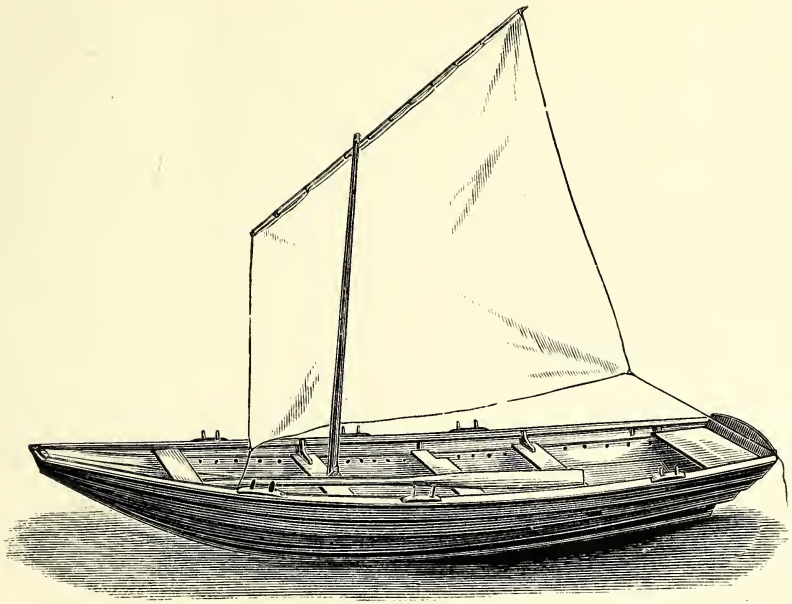


PLATE XXII.—*Norwegian praams.*

[Page 506.]

Six-oared boat of Arendal. Plates XXIII, XXIV.

Bateau à six rames d'Arendal.—This boat (Plates XXIII, XXIV) is much like that employed on the western shore, but is not so generally in use. Narrower boards are used in its construction, these boards being of oak, while those of Plate XXI are always of pine. It is not well adapted to rough seas, nor is it easily propelled by oars. The prow, as well as the stern, is somewhat lower. The keel continued does not end in two high staves, as shown in Plate XXI.

PLATE XXIII.—*Norwegian six-oared fishing boat.*

[Page 508.]

PLATE XXIV.—*Six-oared fishing boat of Norway.* [Page 508.]

D.—Apparatus used in fish culture.

Apparatus used in fish culture.

In this department also the fullest representation was made by M. Carbonnier. The arrangement of ordinary tin troughs with hatching trays, made familiar by their long use in the College of France, a neat hatching and nursing tank constructed of tiles, and implements used in the care of the eggs were found in this exhibit.

M. Carbonnier.

In the fresh-water aquarium of Trocadéro was shown a model of the apparatus designed and used by M. Haak, the superintendent of the government establishment at Hüningen, for retarding the hatching of the eggs of the Salmonidæ by the use of water obtained from melting ice. The apparatus consisted of a rectangular box (the sides being non-conductors of heat) provided with a perforated tray in which ice was placed, the drippings from which passed downward through successive but separate layers of flannel cloth or trays, which supported the eggs, and at the same time absorbed and retained enough of the cold, dripping moisture to saturate them and greatly retard their development. M. Haak reports that by this method he has successfully retarded the hatching of the eggs of the *sabling* for the period of five months, at the end of which time healthy and vigorous young fry were produced.

The aquarium of the Trocadéro. M. Haak.

Hatching apparatus at Hüningen.

In the buildings devoted to the display of oystercultural methods and implements were exhibited specimens of two forms of fish-hatching apparatus used in France and Germany, upon the importance of which great stress was placed, and it was observed with some surprise that they were mere modifications of American devices.

Fig. 4 represents an apparatus designed by Mr. Williamson and used many years ago in California. The modification in this instance consisted of a metallic vessel having a movable tray, which, complete in itself, would represent a section of the Williamson trough, in which the same flow and direction is given to the water by the arrangement of the partitions. The efficiency of the Williamson trough is attributable in large measure to the number of trays used, as the capacity of the trough is thereby very materially increased. The European apparatus, as exhibited, contained only one tray, whereas the California machine used four or five. The apparatus, as shown in Fig. 4, consisted

Williamson's fish-hatching apparatus.

Fish-cultural apparatus.

of a rectangular box having the tray (*a*) provided with a fine wire bottom (*b*) and suspended in position by means of a horizontal rim which projected over the sides of the box. A spout (*c*) allowed the escape of the water; the direction of the flow is indicated by an arrow. The inner box or tray was

Williamson's fish-hatching apparatus.

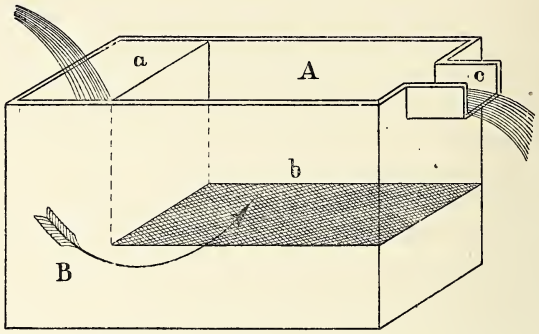


FIG. 4.—*Williamson's California fish-hatching apparatus.*

about 12″ in length by 8″ or 10″ in width and 16″ in depth, which dimensions have been generally adopted in France and Germany. The outer box was about 16″ in length, and was $\frac{1}{8}$″ wider and 3″ or 4″ deeper than the tray. The bottom of the tray is composed of wire cloth of about 15 threads to the inch, and is doubly coated with asphaltum varnish, the use of which is familiar to the American fish-culturist. The material employed in the manufacture of these vessels is usually faced with zinc to prevent corrosion.

Fig. 5 represents a modification of an apparatus said to

Wilmot's fish-hatching apparatus.

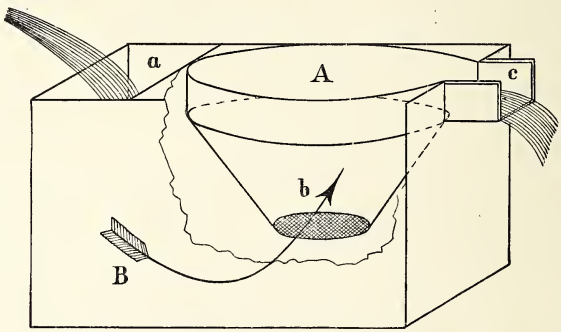


FIG. 5.—*Wilmot's fish-hatching apparatus.*

have been designed by Mr. Wilmot, of the Canadian fishery force. It is quite similar to that shown in Fig. 4, except as to the suspended tray (A), which is in the form of a truncated cone. The current of water is more evenly diffused by this form of tray, but since the hatching area is at the same time greatly diminished, this apparatus is better adapted for

the eggs of white fish than for those of larger varieties of the salmon family. By the use of either of these forms of apparatus the care of the eggs is rendered a very simple matter, the dead ones being readily detected and removed from the trays, while the upward flow of the water serves, in a great measure, to prevent the deposit of sediment upon the living ones. When such a deposit is made, however, from any cause, it can be easily removed by gently raising and lowering the tray in its place, or, if this plan should not prove effective, by drawing off all the water from the outer tank and gently sprinkling the eggs by means of a small watering pot until they are relieved of the sediment. Fish cultural apparatus.

M. Carbonnier exhibited several vessels specially designed for the transportation of fish. An ingenious contrivance for shipping the hardier varieties by public conveyance, and without an attendant, was a vessel supplied with wicker-work and so formed as to render it proof against loss of all its contents by an accidental upsetting at the hands of careless express agents or railroad attendants. A more elaborate apparatus, designed by M. Carbonnier, was also exhibited, and is described by him as follows: Fish-transporting apparatus. M. Carbonnier.

"The question of the transportation of live fish is a somewhat intricate one. Hitherto, when it has been desired to send them great distances, we have only proceeded by way of experiment; hence such a want of success. Nevertheless, the few results that have been obtained may put us on the right track.

"The following conclusions may be drawn, viz: That if we confine for several weeks in dark receptacles fishes which usually live in a bright light, as most of them do, a byssus is formed upon their scales and fins which causes their death in a few days. On the contrary, fishes which frequent deep bottoms, or which live most of the time concealed under stones, are more easily transported in the dark, the water being changed twice a week, and this change of water is the more necessary as when it is without light it becomes corrupt in a few days. At 20 to 25 degrees of heat, infusoria will be developed in large numbers in 48 hours. This phenomenon is of much rarer occurrence in well-lighted waters. Conditions necessary to be observed.

"Only healthy fishes must be selected for transportation; they should be from 5 to 6 centimeters (about 2″) in length, and in a good condition of body. They should be previously allowed to remain in pure water in order to digest all their food (24 hours is generally sufficient for this), and if the length of their voyage does not exceed a month they should be deprived of food. Each fish should have at least half a liter (about 1 pint) of water to move about in, and this should be renewed as frequently as possible. If a special apparatus cannot be had, vases of glass or of earthenware, with large openings covered with thin linen cloth, should be preferred for the voyage of surface fish; for others any article may be utilized. Selection of fish. Relation of capacity of tanks to fish.

"There are cases, in long voyages for instance, when food becomes necessary, and it has been advised to give farinaceous food or the yolk Food.

Fish-transporting apparatus.

of hard-boiled eggs.* Farinaceous articles and the yolks of eggs grease the vases in less than one day; if a fish is removed when in this state it is oily and sticky; a few hours afterwards it dies of asphyxia.

"Notwithstanding the isolation in which one is at sea, on board of vessels there are always resources at one's command; a few flies, cheese-worms, small shreds of meat—this is the food that should be given. All the pieces that have not been devoured should be taken out a few hours afterwards; this is of great importance.

Food.

"It is to these means and to these special precautions, given by me as instructions, that I owe the success of which I have the honor to lay before you an instance—the arrival of these American fish in France."

[Fig. 6. is a view of the Carbonnier can for the transportation of live fish to great distances.]

Carbonnier's fish transporting can.

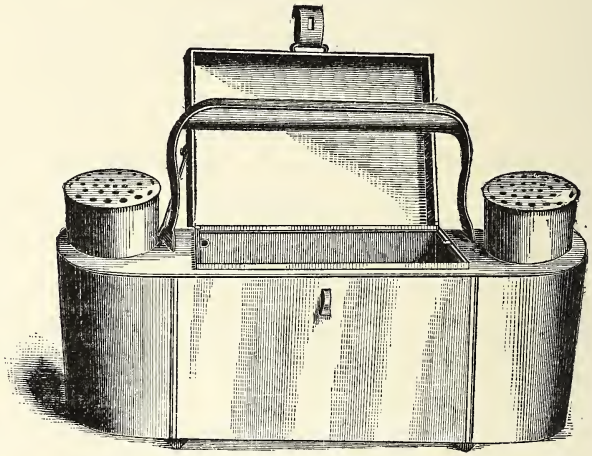


FIG. 6.—*Carbonnier's can for transporting fish.*

Description.

"This apparatus, which is made of tin, is in the shape of a basket, slightly compressed at its two lateral faces; its total length is 40 centimeters ($13\frac{3}{4}''$), its width 16 centimeters ($6\frac{1}{4}''$), its height 15 centimeters ($6''$); it contains about 10 liters (10 quarts) of water. A handle placed on the top facilitates its removal from place to place. It is very portable, and a person may carry it anywhere without difficulty.

"On the top there is a frame, 20 centimeters long (nearly $7''$) by 16 ($6\frac{1}{4}''$) wide, which is intended to receive a pane of glass; this glass, which is kept in its place by tenons, can be removed at pleasure; this permits any necessary manipulation, such as cleansing or airing the fish. A lid made of polished tin, with hinges, covers all this transparent part of the apparatus; when open it serves as a reflector, and a bar (*crémaillère*) renders it possible to incline it at different angles in order to reflect upon the surface of the water the necessary quantity of light.

"At each extremity of the apparatus is a large neck (*goulot*), the covers of which are pierced with air-holes; one of these openings serves to admit water to the fish.

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* It is, however, necessary to guard against the use of these articles of food, which, I am certain, have been the chief cause of our want of success.

M. Carbonnier's fish-transporting can.

"Upon the cover of the second neck is soldered a metallic cylinder, 12 centimeters (4¾″) long and having a hole at its base. This cylinder is intended to receive small pieces of charcoal, which, when thrown into the water, keep it in a good state of purity. In order to prevent the fish from striking against the rough surface of the metallic cylinder, a perforated partition has been made in the interior.

"A thin lining of zinc fixed upon one of the immersed faces of the apparatus preserves the parts from oxidation, while it neutralizes or considerably reduces the production of infusoria. This physiological cause of the diminution of the multiplication of infusoria in a medium in which but little electricity is set free, and in which but little hydrogen is produced, a fact which my numerous experiments have frequently permitted me to establish, deserves the attention of specialists.

"Such are the principal features of this apparatus. By facilitating the constant surveillance which should be given to the fish kept in it, it fulfills all the desirable hygienic conditions."

M. Berthelin.

M. Berthelin exhibited another ingenious vehicle for transporting young fish, which was mounted upon two wheels, and the revolving axle of which operated an atmospheric pump for the purpose of forcing a supply of air into the box while *en route*.

Baron Simon Revay.

The enumeration of articles, etc., in this department of the Exposition may be closed by an allusion to the establishment of Baron Simon Revay, a model of which was shown in the Austrian section, but contained nothing in the way of apparatus or illustration of methods employed with which fish culturists of Europe and America were not already familiar.

French laws regulating the capture of fish.

E.—LAWS REGULATING THE CAPTURE OF FISH AND PROVIDING FOR THEIR PROTECTION.

Although the artificial culture of fish received its first impetus in France, and has led to the establishment of a number of flourishing fish farms in both France and England, yet in both of these countries more attention and energy is devoted to the protection of the fish by law than to restocking the depleted waters by means of artificial propagation.

Local requirements and conditions doubtless have, in a great measure, directed the legislation in the interests of the new industry, but as a most complete and thorough protective system has resulted in France, and as the streams in America are fast becoming depleted for the want of such protection, it may be well to insert a short digest of the French system.

Digest of the French regulations on the capture and protection of fish.

DIGEST OF THE PROVISIONS OF THE FRENCH REGULATIONS.

The right to fish is to be exercised for the benefit of the state (under whose exclusive control it is placed by law):

1st. In all streams, rivers, canals, and dikes navigable for vessels, towboats, or rafts, and maintained by the state or its assigns.

2d. In the arms of streams, in meadows, and in drinking places which derive their waters from streams or rivers navigable for vessels or rafts, which a fisherman's boat can at all times easily enter, and which are likewise maintained by the state.

The right of fishing is to be awarded by public sale or by licenses issued at a certain price. Licenses will be given only in the event of a sale being impossible. The chief provisions of the "code," having in view the preservation and protection of fish and the restocking of certain streams with desirable varieties, are the following:

It is forbidden to place in rivers or streams navigable for vessels or rafts, or in canals, any dam or apparatus the object of which is entirely to prevent the passage of fish.

It is forbidden to throw into the water drugs or bait of such a nature as to injure, intoxicate, or destroy the fish. Penalty, $6 to $60, and imprisonment one to three months.

It is forbidden to take the salmon, trout, etc., from October 20 to January 31.

The taking of all other kinds of fish and of crabs is forbidden from April 15 to June 15.

This prohibition includes all manner of fishing, even with the float-line, held in the hand.

It is forbidden to take salmon less than $9\frac{4}{5}''$ in length, or trout, etc., less than $5\frac{1}{2}''$ in length. If taken below the sizes indicated, they must be thrown back into the water.

The meshes of the nets for taking salmon are defined.

The method of determining size of meshes of nets is defined in the code.

It is forbidden to use, simultaneously, nets or implements of different kinds on the same bank or on opposite banks.

It is forbidden to use, simultaneously, several nets or implements on the same bank or on opposite banks, except at a distance of treble their extent.

It is forbidden to use drag-nets, except such as are known as scoop-nets, to be managed by a single person.

It is forbidden to place in streams any apparatus the object of which is to collect the fish in inclosures, ditches, or pools from which they cannot escape, or to force them to swim through passages in which snares are set.

Digest of the French regulations on the capture and protection of fish.

It is forbidden to place weirs, obstructions, or permanent nets near sluices, dams, natural pools, flood-gates, mill-races, or fish-ladders.

It is forbidden to fish with any implement other than the floating line held in the hand, within sluices, dams, flood-gates, mill-races, or fish-ladders, or at a distance of less than 30 meters (100′) above or below such places.

It is forbidden to use fire-arms, blasting powder, dynamite, or any other explosive substance for the purpose of catching or destroying fish.

It is forbidden to expose for sale, sell, buy, transport, peddle, export, or import the various species of fish during the time when it is unlawful to take such fish.

These provisions do not apply to ponds or reservoirs; but whoever, during the period of prohibition, shall expose for sale, sell, etc., any of the prohibited varieties of fish shall be obliged to furnish proof that such fish were lawfully caught. The law further provides that whoever has in his possession any prohibited fishing tackle or implements shall be obliged to furnish proof that they were intended for fishing in ponds or reservoirs.

The provisions relative to fishing and to the transportation, etc., of fish are also applicable to spawn and young fish.

Fishing shall be allowed only from sunrise to sunset; and the law also provides that fixed nets, etc., shall be raised "by the middle," 36 hours each week (from Saturday at six o'clock in the evening until Monday at six o'clock in the morning), in such a manner as to leave for the free passage of the fish a space 19.68″ in height. Fishing may be prohibited during the entire year, but not for a longer period than five years.

The law provides for the erection of fish-ladders at certain points to secure the free passage of fish.

Prefects, in their respective districts, may determine the proper measures to be observed in emptying into streams, etc., the dye-stuffs and other refuse and noxious matter discharged from factories and other industrial establishments.

The law also provides that no party to whom an award has been made shall be entitled to indemnity or reduction of the price of his lease by reason of any inconvenience or damage resulting from unavoidable accidents, or from the navigation service, or from the work of repairing, etc., canals, dikes, etc.

In the event, however, of his fishing operations being materially disturbed, he may have his lease annulled, if he so desires. The exercise of this power is, however, discretionary with the proper authorities.

Parties receiving awards shall make proper arrangements with riparian proprietors for the use of such land as they shall need for the purpose of drawing up their nets, etc.

Appendix I contains "Practical instructions for the restocking of streams."

The law provides that parties receiving awards shall see to it that the regulations in regard to the management of flood-gates of factories, etc., are properly executed. They shall ascertain whether the water is directed at the prescribed times into the ladders erected for the fish. In case of violation they shall report to the agents of the department of roads and bridges.

Digest of the French regulations on the capture and protection of fish.

They are further enjoined to protect, in their respective fishing districts, the most useful fish, and such as are best adapted to the nature of the water. For this purpose they shall establish artificial spawning grounds if the natural spawning grounds are insufficient or defective. They shall aid the officers of the department in artificial fecundation.

They shall transport, at their own expense, eggs fecundated naturally or artificially to the places that are most favorable to their incubation and development. They shall also transport, at their own expense, young or adult fish to those parts of streams that need to be restocked.

The law also provides for the appointment of agents, fish-wardens, etc., whose duty it is to protect the fish and enforce the fish laws in their respective districts.

A "list of offenses and penalties prescribed" is contained in the law.

THOMAS B. FERGUSON,
Additional Commissioner.

APPENDIX I.

PRACTICAL INSTRUCTIONS FOR THE RESTOCKING OF STREAMS.*

French instructions for restocking of streams.

Division of fresh-water fish according to their usefulness.

Divisions of fresh-water fish.

Fresh-water fish are divided into two classes.

The first, among which are the bull-head (*chabot*), the loach, and the greater part of the bleak tribe, such as the roach, the randosia, the blay, the rotengle, the minnow, etc., generally very little esteemed, and of very small size, do not offer great resources to the public consumption.

The other, among which are all the species of the family of the salmon, the carp, the bream, the perch, the tench, the pike, the eel, etc., enter, on the contrary, to a large extent into the food supply of man.

Special attention must be paid to the propagation of the latter, use being made for this purpose of fecundation, incubation, artificial hatching, arrangements calculated to favor the laying of eggs, to render it possible where it would not have taken place, protection of the reproducers, laying beds, and young fish.

Nature of the water in connection with the kinds of fish.

Adaptation of waters to certain fish.

In order to operate rationally and with some chance of success, the conditions of the medium which is proper for each kind are important matters to be known.

All waters, the nature of all bottoms, and all temperatures are not equally well adapted to the multiplication and the speedy development of all fish.

Running and clear water, flowing over beds of sand or pebbles, and whose temperature during the prevalence of severe heat does not rise above 16° centigrade, is particularly favorable to the salmon, trout, and char.

The so-called summer fish, such as the carp, tench, bream, etc., do not thrive under similar conditions. Their growth is then very slow, and their reproduction amounts to little or nothing. They require, as do all white fish, waters of ordinary richness, tranquil, with a muddy or marly bottom, and whose temperature during the summer season rises to 20° centigrade and upwards.

Time of laying and conditions in which it takes place.

Time and conditions of reproduction.

The period of reproduction, the conditions under which each species spawns, are not less necessary to be known, that suitable measures may be taken in due season to favor the laying of eggs, and to obtain subjects whose eggs are sufficiently matured to permit artificial fecundation.

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* "*Code de la Pêche Fluviale. Instruction pour Les Gardes-Pêche. Instructions pratiques pour le Repeuplement des cours d'eau.*" Paris. Imprimerie Nationale, MDCCCLXXVI.

French instructions for restocking of streams.

Although the period of spawning for each species varies according to the climate, and even according to the advancement of the season, it may nevertheless be fixed in a general way as follows:

From October to January for trout, salmon, char, and the ell pout (*lotte*).

In February and March for the pike.

In April and May for the barbel, bream, sandre, common char, and perch.

From June to the end of August for carp, tench, and gudgeon.

Each species reproduces but once a year.

The conditions under which these various fish lay their eggs present almost as much variety as the time of laying.

Thus, the trout, salmon, and char deposit them and bury them in beds dug by them in banks of pebbles or gravel, washed by fresh running water.

Time and conditions of reproduction.

The carp, tench, and pike attach them to the plants which grow and float in the calm and warm waters near the shore or in shallow bottoms.

The barbel, bream, and gudgeon scatter them over gravelly bottoms where they are exposed to currents.

Finally, the perch lay them in a mass having the form of an elongated purse, and intertwines them among the roots, submerged branches, and aquatic vegetables which it finds in tranquil waters.

Artificial fecundation.

Multiplication of fish by artificial processes.

In a state of nature the eggs of fish are subjected to various causes of destruction. Not only may the eggs be disturbed and their development arrested by conditions accidentally introduced in their food supply in the water, but also their number is constantly diminished by a multitude of insects, water-fowl, and especially fish which prey upon them.

Thus it is seen why the multiplication of the various species stands in so low a ratio to their excessive fecundity. In order to promote this multiplication we must place the eggs beyond the reach of their enemies and of the causes which may injure them; which result can be obtained by artificial fecundation and the processes connected therewith.

Condition of eggs and milt favorable to reproduction.

Conditions of eggs and milt favorable to fecundation.

Whatever may be the species which it is desired to multiply artificially, it is impossible to operate with success if the milt in the male and the eggs in the female are not ripe and sound.

To obtain them under such conditions, the best means is to catch the subjects when they frequent the spawning grounds. Nevertheless, even when they are taken at this time, the laying is not always so near at hand that it may be expected to take place immediately. In this case the fish just taken are placed in ponds, and a few days usually suffice to bring the eggs and the milt to the desired state of maturity.

Signs of the maturity of the eggs.

The eggs are ripe when they are free in the belly of the female. Signs visible on the outside reveal this maturity. The flesh around the anus is red, swollen, and projects like a pad, and in many cases eggs which have fallen by their own weight have become stuck in this pad and are seen through it by transparency. The belly is soft, yields to pressure easily, and the eggs are felt to move from side to side under the touch of a person's fingers. Finally, the slightest effort, even the mere suspension of the fish, is sufficient to cause the depositing of the eggs.

But these signs of maturity are manifested as well when the eggs are healthy as when they are not so. It is only possible to judge of the condition after some have been received in a vessel containing water.

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Sound eggs, at the moment when they are deposited, are rather transparent than opaque. They are of a flesh color, and the slimy coating which covers them does not become whitened by contact with the water.

Signs of maturity of the eggs.

Unsound eggs have a muddy color, and are sometimes wholly or partially opaque. At other times, while extremely transparent, they have a central nucleus more or less extensive, and the mucous matter which surrounds them, and which is usually seminous, whitens and disturbs the water into which they are cast.

To attempt the fecundation of eggs possessing such characteristics would be time lost; they must be rejected.

In the male the milt is ripe when slight compression along the sides, or merely the efforts made by the fish in struggling, cause it to be deposited.

It is sound and in good condition if it has the color, the consistence, and fluidity of cream.

Maturity of the milt.

The milt which is obtained by means of strong pressure, which comes out in thick drops which are with difficulty diluted in water, of a yellowish or reddish tint, is unsound, or has not yet reached maturity—consequently, has not its fecundating virtue. It should not be used.

Success depends, therefore, upon the choice of subjects and the state of the eggs and milt.

It is proper, as far as possible, to operate only with live fish. However, fish that have been dead for a few hours may be used, provided their milt and eggs present the signs that are characteristic of soundness.

Processes of artificial fecundation.

Process of artificial fecundation.

In order to accomplish fecundation thoroughly and rapidly, it is necessary, in the first place, whatever be the species whose eggs it is desired to fecundate, to place in two buckets filled with water, on one side the males, on the other the females, that are to be used.

It is also necessary to consider whether the eggs to be fecundated remain free, like those of the salmon or trout, or whether in falling they attach themselves to foreign bodies, like those of the carp, tench, or barbel. This difference in the manner in which the eggs act requires a difference in the manner of proceeding.

In the former case the proper method of operating is as follows:

In case of eggs which remain free.

After having procured a vessel of porcelain, wood, or glass, having a wide and flat bottom, or even a very clean pail, it should be filled half or one-third full of pure and limpid water, at a temperature of from 5° to 10° centigrade for the species in question (trout, salmon, and char). This being done, the female is taken in both hands, but in such a manner that her head will be in the left hand and her tail in the right hand. As soon as she has been seized and has ceased struggling, she is brought near to the vessel and delivered by pressing her sides gently between the thumb and other fingers of the right hand, which must be caused to slide from the head to the tail as often as necessary.

It sometimes happens that the first effort is not attended with any result; the female retains her eggs by violent contractions. In that case no attempt must be made to hasten matters, but it is proper to wait. A few seconds are ordinarily sufficient for this spasmodic state to cease, and the eggs then pass without difficulty.

The first operation having terminated, and the water having been changed if it has been soiled by the deposit of mucus or by excrement from the female, the male must immediately be seized and a few

French instructions for restocking of streams.

drops of milt extracted by the same process. The dispersion of this over the eggs is then facilitated by causing a slight agitation in the water (which should then assume a very slight opaline tint), either with the hand, with a feather, or even with the tail of the fish.

The same male will furnish sufficient semen to impregnate the eggs of several females.

About one minute's repose renders the impregnation sufficient, and the eggs are washed by renewing the water several times in the vessel that has received them.

All these operations may be executed by a single person when the subject is small, but fish weighing from 2 to 3 lbs. require the aid of an assistant, whose duty it is to hold with a linen cloth the tail of the fish, in order to render its contortions less violent.

One and sometimes two assistants are necessary for fish weighing from 5 to 6 lbs. and upwards. The operator who has charge of the expulsion of the eggs cannot do it well in such cases save by compressing from front to back with his hands the sides of the female, which is suspended by the gills by one assistant while the other firmly grasps her tail, in order to prevent any sudden movement.

Process of artificial fecundation,

Usually eggs which are to be laid by a female get ripe at the same time, and are detached simultaneously from the ovary, and are simultaneously in a condition to be fecundated. Nevertheless, salmon and trout when left to themselves lay their eggs at different times, and are several days in spawning. In order to imitate the process of nature, therefore, it is proper, after having obtained from a female and a male a certain number of eggs and the quantity of semen which is necessary to fecundate them, to allow the subject to repose in a pond for a day at least before repeating the operation. But what may be done with impunity with fish that are intended for market, and that may be kept for some time in narrow places, becomes injurious to those which it is desired to reserve as reproducers.

in eggs which remain free.

Repeated operations fatigue and injure them, and finally prove fatal. It is, moreover, preferable to deliver them of all their eggs at once, and immediately to set them at liberty.

If these eggs are too abundant, which happens when one has to do with females weighing from 3 to 4 lbs., they should not be all received in a single vessel and fecundated in a mass. They should be distributed in various vessels, and little lots of from 3,000 to 4,000 be fecundated separately.

Fecundation of eggs attached to other bodies.

Fecundation of eggs which are attached to other bodies.

For eggs which become attached to the bodies on which they fall, such as those of the carp, tench, etc., the method of fecundation varies somewhat from the one just described.

Several pails, of a suitable size, containing water at a temperature of from 16° to 20° centigrade, aquatic plants or little sprigs of heath, and tufts of certain shrubs are necessary, and three persons must simultaneously take part in the fecundation.

Process.

One seizes the female and, by the manipulations above described, delivers her of a portion of her eggs; the other seizes the male at the same time, from which he squeezes a few drops of milt; the third, finally, receives the two products on the tufts of grass or bunches of heath immersed in the pail, and favors their mixture by gently moving these tufts and turning them, in order that some of the eggs may become fixed on the tufts of grass, etc.

Here, fecundation is necessarily partial. When a tuft is suitably covered with eggs it is immediately passed to another pail, and the same operation is performed until the fish that are being operated upon are nearly exhausted. *French instructions for restocking of streams.*

The fecundation of the carp, tench, and all fish whose eggs adhere, requires, as is seen, more care than that taken with salmon and trout, and gives no less favorable results when properly executed.

These fish, moreover, may be multiplied by a more simple method, which renders recourse to artificial fecundation unnecessary. It is sufficient to place, at the time of reproduction, in reservoirs, dikes, and even pools, supplied by natural, pure, and warm water, several adult couples of the species which it is desired to propagate (carp or tench for instance), in order to obtain an abundance of eggs, especially if care be taken to create in these basins artificial spawning grounds when vegetation does not furnish good laying conditions therein. Fecundation of eggs attached to other bodies.

Transportation of fecundated eggs. Transportation of fecundated eggs.

If the eggs artificially fecundated are to undergo incubation in apparatus arranged beforehand on the spot or in the vicinity, they are poured directly into that apparatus as the operations are accomplished.

If they are to pass over a great distance before reaching their destination, they are then placed in conditions which, while diminishing losses, render their transportation more easy. These conditions vary according to the state of the temperature and the nature of the eggs.

For free and resisting eggs wooden or tin buckets are kept, in which they are placed, without water, in layers one above another, between moss that has been previously washed and well twisted. The humidity which it retains after being washed and twisted is sufficient to prevent the eggs from becoming dried.

In cases where frost is to be feared, the box containing the eggs is inclosed in a larger one, and the empty space between the boxes is filled up either with perfectly dry moss or with hay, sawdust, or other substances which oppose the direct action of the cold.

Eggs adhering to foreign bodies, such as those of the carp, roach, etc., cannot be transported as far as the eggs of the salmon or trout. The slight power of resistance of their membranes rendering them too liable to be injured by contact with surrounding objects, it would be imprudent to carry them a journey of two or three days.

If the distance which they are required to travel is one of a few hours only, pails full of water, in which the bodies to which they adhere are plunged, are used for their transportation.

If the distance is greater, the bodies supporting the eggs are inclosed in small bunches in a basket, care being taken not to pile them up too much upon each other, in order to avoid concussion, and care being likewise taken to surround each bunch by a single or double wet linen cloth.

The eggs which are agglomerated, like those of the perch, are still more delicate than those of the tench and carp, and require greater care. They must not be transported between grasses, herbs, or cloth, especially if they are to go a considerable distance, but in glass jars or pails, being three-fourths full of water of the same temperature of that originally used in incubation.

Incubation of eggs.—Apparatus required by it. Incubation of eggs.

Whatever be the process by means of which eggs have been procured, whether these eggs be free, adhesive, or agglomerated, they should by Apparatus.

French instructions for restocking of streams.

no means be left to chance in running water or in ponds. They must be protected from causes of destruction, which in nature sometimes affect whole generations. This can be done by placing them in particular conditions.

The apparatus with continuous current, formed of trenches or little troughs of varnished earthenware 50 centimeters (19″) long, 15 centimeters (5¾″) wide, and 10 centimeters (4″) deep, in which is fitted a hurdle with glass rods, is perfectly well adapted to the incubation of the eggs of the trout, salmon, and char, and its use is attended with the most favorable results.

The incubation of eggs, in apparatus with continuous current.

This apparatus, which is entirely harmless and easily washed, renders it possible to observe the cleanliness which is necessary for the hatching of the eggs, and easily adapted to all circumstances.

It may be reduced to a single trench, supplied by the water of a fountain, a cask, or of any receptacle whatever. The trenches may be multiplied; they may be arranged on parallel series, or scaffoldings in the form of steps; or they may be placed side by side in a double row of steps corresponding to each other, like those of a double staircase.

A little stream of water, which is regulated at will by a faucet, secures, in falling from one trench to another, a current which secures the regular development of the eggs, if these eggs are not piled upon the hurdles. One row, or two at most, forms convenient layers.

In brooks with pebbly bottoms.

In default of apparatus of this kind, the eggs of salmon, trout, or char may be developed in natural brooks having pebbly bottoms, provided they be protected from all accident and the water be rather cold than hot, being neither very deep nor very rapid.

The lavaret.

Among the species of salmon there is one, the lavaret, which inhabits lakes, and which may be advantageously acclimated in the large reservoirs of canals by reason of its great fecundity. The incubation of its eggs must be conducted in the same manner as that of the eggs of the trout. They may also be sown like grass on beds of pebbles and gravel in shallow water, or rather they may be spread upon beds of moss partially submerged, in which capillary attraction secures a constant humidity.

If these mosses be put in hatching apparatus, the water must flow out through the openings made in the lower portion of the stream, opposite to that by which the current enters.

When the hatching is close at hand the passage of escape is closed, the trough is filled, and the young fish that are hatched can then move about freely. But instead of leaving them in the apparatus, as is done with the other species of the same family, it is necessary to throw them quickly into the water which it is designed to stock, because they are of a roving nature.

Hatching of adhesive eggs.

The apparatus with a continuous current serves also to hatch the adhesive eggs which, like those of the barbel, require running water for development.

The salmonoids.

The most suitable temperature for the eggs of the salmonoids, in whatever condition they may be placed, is that which offers the least variation and remains between 6° and 10° above zero, centigrade.

Carp, tench, perch, bream, etc.

As to the eggs of the carp, the tench, perch, bream, etc., their incubation is accomplished perfectly well and safely in wooden tubs, or large and perfectly clean pails which have contained no injurious substance. The planks to which these eggs are attached are immersed therein, and the water is kept at a temperature of from 12° to 15° centigrade for perch, and at 20° to 25° centigrade for carp and tench. In

order to obtain this result, the pails are shaded with a linen cloth from the heat of the sun's rays, to prevent the water from reaching a temperature above that named. They are covered with boards or moss if the cold tends to lower it too much. *French instructions for restocking of streams.*

After the hatching, the young ones are poured, with the water that contains them, into the basin or the stream which it is intended to stock.

For the incubation of adhesive eggs, osier baskets, open-work boxes or baskets, may be used; these are placed—after the bodies on which their eggs are attached have been placed in them—in the coves of rivers or the little natural inlets where the water is calm, very shallow, and where the temperature is favorable to the development of the species. Apparatus for the incubation of adhesive eggs.

In order that these implements may not be removed, they are attached to a cord fastened to the shore by a stake.

The development takes place of itself; the young fish, after being hatched, immediately disperse in the water in which their development has taken place.

Duration of incubation.—Care to be given to the eggs of salmon, etc., during this period. Duration of incubation.

The duration of the incubation varies according to the species and the temperature of the water. Under normal conditions it is from 10 to 15 days for the carp, tench, and barbel; about 20 days for pike and common char; 1½ to 2 months for the trout and salmon. The latter, during this long period, require some little care. Thus, for every two or three days the eggs which have become white should be removed with nippers. These eggs, being dead, become the seat of a parasitical vegetation, which injures the others if they are not removed. It is also necessary, during the first two weeks, to avoid agitating them, and especially transporting them, no matter how small the distance may be. Perfect repose is absolutely necessary to them during the first few days. Care during incubation.

Subsequently, when the shape of the young fish is well marked, when the eyes, like two blackish points, show through the external membrane, the movements or the agitation which may be necessary is no longer attended with the same danger. One can then, if necessary, cleanse the apparatus of the sediment which the water may have deposited there, draw the hurdle and its contents from the little troughs, and transfer the eggs from one hurdle to another.

This is also the period of development which must be selected for their transportation. For this purpose the process is the same as for free eggs whose fecundation is desired. When arranged in layers in boxes, upon damp moss, they reach their destination securely. When replaced for incubation, after being unpacked, they continue their evolutions and are not slow in hatching.

Care required by the young fish after birth. Care of the young fish.

After hatching, the young fish do not all show the same instinct. The majority of those called white fish and summer fish, like the carp, disperse almost immediately in the water, and, in consequence of their vivacity and smallness, require no kind of protection. What is essential for this species is that the water in which they are developed, and into which they are thrown when turned loose, should offer good conditions of security, shelter, and temperature.

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The species of the salmon family—the lavaret excepted—have, on the contrary, on leaving the egg, an enormous pouch or umbilical bladder, which condemns them to immobility, and renders them incapable of avoiding by flight the voracity of their enemies.

The action of man must, therefore, here interfere, and it can do so efficiently by preserving these valuable fish in the apparatus for some time. They must be left there in the most absolute security, sheltered from the bright light, and without food. The element contained in the enormous vesicle which they carry supplies their needs for about one month. When this vesicle is on the point of entire absorption—which takes place towards the end of five or six weeks—they are then withdrawn from the earthen trenches, either to be placed in little brooks, in basins designed for young fish, from which all destructive agents have, as far as possible, been removed, or to be conveyed directly to the ponds or rivers which they are designed to stock.

Care of the young fish.

Transportation of the young fish.

Method of transportation of the young fish.

The younger the fish the greater the security with which they may be transported.

For the transportation of fish which have lost, or are on the point of losing, their umbilical vesicle, glass jars are used, capable of containing from 2 to 3 liters (3 quarts), which are contained in baskets with compartments (bottle-baskets for instance), and nearly two-thirds full of fresh and limpid water. The jars should not contain more than 500 or 600 fish. In this way they can be conveyed for great distances with little or no loss, if care be taken to renew a considerable part of the water in the jars from time to time during the journey. This precaution is especially necessary when the temperature of the air is high, but in this case it is well to use ice, small portions of which are placed successively in the jars.

Jars.

If it is required to transport fish which have already attained a size of 5 or 6 centimeters (2″), the glass jars are insufficient. Small casks with a large opening, well cleansed by long steeping of the noxious substances that may be found in the wood, will then fulfill the conditions which are necessary. They are about half filled with water at a low temperature, which is likewise renewed during the journey, if possible, and which is aerated from time to time, by the aid of a pump, with a continuous jet of water. Several thousands of young fish may thus be transported to a great distance.

Casks.

The fish of a pretty large size are transported by the same means, but in small numbers only.

The eel is one of the fresh-water species that may be taken in large numbers. Its flesh is esteemed, its growth rapid. It is important to introduce it, in as large numbers as possible, in streams that do not contain it. This can be done the better as it is taken, when young, in prodigious quantities. It is thus taken annually in all large rivers at the syzygies of April and May.

Transportation of eels.

In order to transport eels from the place where they are taken to that to which it is designed to take them, the method which has hitherto been most successful is that which consists in placing the young eels, without water, in close baskets, at the bottom of which is placed an old linen cloth or some strong paper, and which are then filled with straw, well soaked, to which a few aquatic plants are added; the straw, however, must not be too much heaped up. Baskets thus arranged are capable of containing from 4,000 to 5,000 young eels.

Arrangements suitable for the natural laying of eggs.—Spawning grounds.

French instructions for restocking of streams.

The agency of man must co-operate with these means of propagation, either to take care of the natural spawning beds, or to multiply them artificially when they are insufficient, or to create them when they do not exist or when they have been destroyed.

Spawning grounds.

Thus, when it is required to dredge a certain portion of the river which is known to be a place of reproduction for trout or any other species which spawns on pebbles, the operation should not be performed until the hatching time is over, and, if possible, some place should be reserved for the subsequent laying of eggs at the most favorable points.

The same is the case as regards the cutting of herbs in places where fish collect for the purpose of spawning. This cutting should not take place until the time of laying is passed, and if it is absolutely necessary that it be done before, the necessity of the case may be reconciled with the interests of reproduction by leaving tufts of aquatic plants at intervals at the points which are most frequented by fish, and which are the best protected and the least deep.

In those streams which have no natural spawning grounds, and in which, in consequence of works executed on account of the requirements of navigation, they have become entirely destroyed, this lack of conditions necessary for the reproduction can be supplied by artificial spawning grounds, which are established about a month before the time when the fish usually lay their eggs.

The organization of these spawning grounds, their position, and the material proper for their construction necessarily differs for the species for which they are intended.

Salmon, trout, etc.

For the salmon, trout, and umber it is proper to select a brook or the branch of a river of little depth, having a solid bottom, without mud or vegetation, where the water is flowing and limpid, and this bottom should be covered throughout an extent of from 2 to 3 square meters with a layer of from 10 to 20 centimeters of small round stones mixed with gravel. The larger stones should be the size of a man's fists.

The laying beds are prepared for the barbel (and other species whose eggs adhere to stones) with small stones and gravel, arranged in heaps in muddy currents.

Carp, tench, etc.

As to the spawning grounds for the carp, tench, and generally for all other fish whose eggs adhere to plants, they are established either with small cakes of somewhat thick grass, which is arranged side by side, in the form of a meadow, or with aquatic plants, rushes dug up with the earth that sustained them and replanted in groups at the bottoms of rivers, or in flat wooden boxes, or with laths or poles 1½ or 2 meters in length, of which a sort of hurdle fence is made, to which are attached tufts of grass or roots, bunches of heath, small wood, or rushes, in such a manner as to imitate little clumps of trees.

These spawning grounds must be placed at small depths on the gently-sloping borders of creeks or coves, well exposed to the sun and in tranquil and warm water. They should be placed in an oblique or horizontal position, acccording to the locality, and stone ballast is used for sinking these, which are wattled.

Protection of the spawning grounds

The spawning grounds, whether natural or artificial, attract the fish to the same place and render its capture very easy. In order to prevent the devastating effects resulting therefrom, it is proper, wherever surveillance cannot be easily exercised, to protect the spawning grounds and their approaches either by fragments of rocks scattered over the bottom or by the aid of posts solidly driven in at a distance of a few

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meters from each other, and having nails driven into them. This method renders the use of nets, such as the scoop-net, impossible, and nullifies the effect of the seine and other drag-nets.

Spawning grounds.

In order to complete the measures calculated to secure the restocking of streams, natural reproduction must be protected by facilitating the access to the laying places to the fish over the dams; by taking care that the fish are neither taken nor disturbed at the time of spawning; by removing from the spawning grounds whatever can be injurious to the eggs deposited there or to the young fish just hatched.

Ducks and geese, being very destructive to the eggs and young fish, should be carefully kept away from the fishing districts, at least during the period of laying.

APPENDIX II.

MARITIME FISHING STATISTICS, 1876.

REPORT TO THE MINISTER.*

French maritime fishing statistics.

PARIS, *September* 17, 1877.

The report which I had the honor to present last year to the Minister's predecessor, submitting to him the fishing statistics for 1875, contains a statement of the laws governing this important branch of the service of the marine department.

Report of M. De Bon.

I do not desire to recur to that document, which was made public, but in transmitting statistics for the year 1876 to Admiral Gicquel des Touches, I am happy to be able to say that it shows in the yield of the fisheries a very considerable increase.

This increase, compared to the results obtained in 1875, is 11,824,049 fr. ($2,364,809), as shown by the following table:

Increase in the yield of fisheries.

	Fishing in boats.	Fishing on foot.	Total.
	Francs.	*Francs.*	*Francs.*
In 1875, the product of the various fisheries was represented by the sum of	72,378,446	4,788,096	77,166,542
In 1876, the value of the product was	83,530,467	5,460,124	88,990,591
Total increase in 1876	11,152,021	672,028	11,824,049

Table.

These figures relate almost exclusively to the first three maritime districts. In that of Cherbourg (the first), a considerable increase is remarked in the yield of herring; in the second (Brest), the cod fishery of Newfoundland, that of the mackerel, and principally that of the sardines, contribute largely; finally, in the third (L'Orient), the sardine fishery was considerably improved. As to the two other maritime districts, the fourth (Rochefort) and the fifth (Toulon), the results of their fisheries in 1876 present only unimportant variations when compared to the results of the preceding year.

The maritime districts of—
Cherbourg,
Brest,
L'Orient.
Rochefort,
Toulon

The three following tables show for the years 1875 and 1876—

1st. The quantities of fish taken, expressed in kilos, in numbers, or in measures of capacity, according to the nature of the products.

2d. The value in money of these same products.

3d. The number of men and the number of vessels employed, together with the tonnage of these vessels.

* *Ministère de La Marine et des Colonies. Statistique des Pêches Maritimes*, 1876. Paris. Imprimerie Nationale, 1877.

French maritime fishing statistics.

TABLE I.—*Quantities of fishes.*

Table of quantities of fish taken.

Description.		1875.	1876.	Increase.	Decrease.
Newfoundland cod	kilos	14, 955, 928	16, 296, 993		
	pounds	32, 966, 821	35, 934, 870	2, 968, 049	
Iceland cod	kilos	13, 667, 978	11, 589, 479		
	pounds	30, 140, 991	25, 553, 801		4, 587, 190
Herring	kilos	22, 238, 610	26, 061, 536		
	pounds	49, 036, 135	57, 465, 687	8, 429, 552	
Mackerel	kilos	6, 501, 367	11, 863, 478		
	pounds	14, 335, 514	26, 159, 969	11, 824, 455	
Sardines	number	980, 628, 110	1, 198, 402, 181	217, 774, 071	
Anchovies	kilos	666, 736	1, 167, 728		
	pounds	1, 470, 152	2, 574, 940	1, 104, 788	
Other fish	kilos	41, 300, 121	42, 577, 902		
	pounds	91, 066, 767	93, 884, 274	2, 817, 507	
Oysters	number	97, 226, 592	160, 267, 396	63, 040, 804	
Mussels	hectol	345, 991	396, 324		
	gallons	9, 140, 626	10, 470, 358	1, 329, 732	
Other shell-fish	hectol	158, 272	151, 628		
	gallons	4, 181, 337	4, 005, 812		175, 525
Crustacea	number	1, 700, 718	1, 367, 045		333, 673
Shrimps	kilos	1, 158, 075	1, 537, 107		
	met. c	1, 314, 116	1, 375, 064		
	pounds	2, 553, 455	3, 389, 421	835, 966	

It appears from this table that the yield of codfish (Newfoundland and Iceland), of herring, mackerel, anchovies, and of various fish, indicated under the head of "other fish," amounted in 1876 to 109,557,116 kilos (241,025,655 lbs.). These products yielded in 1875, 99,330,740 kilos (218,527,738 lbs.), showing an increase for 1876 of 10,226,376 kilos (22,498,027 lbs.).*

The same table shows an increase for 1876 of 217,774,071 sardines, 63,040,804 oysters, 50,333 hectoliters (1,329,731 gallons) mussels, 379,032 kilos (835,966 lbs.) shrimps, 60,948 cubic meters (*amendements marins*).

On the other hand a diminution is shown of 6,644 hectoliters (175,525 gallons) of various sorts of shell fish, and 333,673 lobsters.

TABLE II.—*Value, in money, of these products.*

Table of value of fish taken.

Years.	Cod fishery.		Coastwise fishery, including that of the mackerel and herring.	Total.
	Newfoundland.	Iceland.		
1875	$1, 546, 929 20	$1, 530, 347 20	$12, 356, 032 00	$15, 433, 308 40
1876	1, 813, 194 00	1, 416, 980 20	14, 567, 944 00	17, 798, 118 20
Increase, 1876	266, 264 80		2, 211, 912 00	2, 364, 809 80
Decrease, 1876		113, 367 00		

* It is to be remarked that while the codfishery shows an increase of 1,341,065 kilos (2,968,049 lbs.) in Newfoundland, it shows a decrease of 2,078,499 kilos (4,587,190 lbs.) in Iceland—a diminution of 737,434 kilos (1,622,354 lbs.)—being the total result of this fishery in 1876 compared with the year 1875.

TABLE III.—*Number of men and vessels employed and tonnage of vessels.*

French maritime fishing statistics.

Years.	Number of men employed.			Number of boats employed.			Tonnage of the boats.		
	Newfoundland cod fishery.	Iceland cod fishery.	Coast fishery.	Newfoundland cod fishery.	Iceland cod fishery.	Coast fishery.	Newfoundland cod fishery.	Iceland cod fishery.	Coast fishery.
							Tons.	*Tons.*	*Tons.*
1875	7,800	4,000	68,651	178	220	20,157	30,295	21,890	101,852
1876	7,417	3,942	68,317	168	228	20,662	28,903	21,923	102,090
Increase, 1876	.....	.....	.....	.....	8	505	.....	33	238
Decrease, 1776	383	58	334	10	.....	.....	1,392	.....	.....

Table of the men and vessels employed.

Cod fishery.

Cod fishery.

NEWFOUNDLAND.

Newfoundland.

Years.	Number of men employed.	Number of boats.	Tonnage.	Number of pounds of fish taken.	Value.
1875	7,800	178	30,295	32,903,041	$1,546,929 20
1876	7,417	168	28,903	35,853,384	1,813,194 00
Increase, 1876	.....	.....	.....	2,950,343	266,264 80
Decrease, 1876	383	10	1,392	.....	.....

Table of force employed, product, and value.

Thus, in 1876 it is seen that there were 10 vessels less than in 1875 for Newfoundland, and, notwithstanding this decrease, an increase of 1,341,065 kilos (2,950,343 lbs.) in the quantity taken, and in the value of this product an increase of 1,331,324 fr. ($266,264.80) in favor of 1876. These figures clearly show that the fishery was much more productive last year than the preceding year. The vessels of Saint-Malo, of Granville, and of Saint-Brieuc contributed most to the improvement shown. On the east coast the cod appeared in abundance in the harbors of the center of this part of the island of Newfoundland; the harbors situated between Fichot and Conche were particularly favored. To the north and south, on the other hand, the fishing was rather poor. The west coast shows the least favorable result; the fishery was really disastrous for the vessels whose crews were established on land and for those which cruised in the gulf.

Increased product.

The herring fishery attracts large numbers of English and American cruisers to the coast of the island of Newfoundland in the month of September. They fish generally with excellent success, and our shipowners cannot be too strongly urged to engage in this fishery on a large scale. They would derive almost certain profit therefrom, and would, by their presence, drive away an entire fleet of rival schooners, which, while fishing for herring, also take the cod when an opportunity offers.

English and American competition.

The English use, for the coastwise fishery in the Gulf of Labrador, fast-sailing schooners, which enable them to follow the cod in its movements. Their boats are lighter and better made than ours for line fishing; our boats have no real superiority save when large seines are used.

Labrador.

French maritime fishing statistics.

It is not to be doubted that for cod fishing on the banks a schooner would be more serviceable than a heavy French vessel, which must be sent with material sometimes 20 and 30 leagues from the center of the fishing grounds.

American vessels.

The Americans, who are daily becoming more numerous on the banks, likewise fish with schooners and wherries.

Our captains, who are frequently among them, are alone able to say what are the best vessels; nevertheless good results are pointed out which are obtained by the English in the use of wherries.

Experiments with Norwegian nets and drag-lines.

In my last year's report I stated that the implements (nets and drag-lines used in Norwegian cod fishing) had been sent to the commandant of the islands of Saint-Pierre and Miquelon, who was to give them a trial. The local commission, charged with the experiments, has expressed the opinion "that these implements are in nowise suitable for fishing off the islands of Saint-Pierre and Miquelon."

This opinion does not seem to be shared by certain ship-owners, as is shown by the orders for similar implements sent by them to Bergen, and by the publication in a newspaper at Saint-Malo of an article refuting the opinion of the commission at Saint-Pierre. In view of these discrepancies of opinion, orders have been sent to the commandant of the station at Newfoundland to experiment with the implements in question.

Iceland.

ICELAND.

Years.	Number of men employed.	Number of boats.	Tonnage.	Number of pounds of fish taken.	Value.
1875	4,000	220	21,890	30,069,551	$1,530,347
1876	3,942	228	21,923	25,496,853	1,416,980
Increase in 1876	.....	8	33	.....	.....
Decrease in 1876	53	.....	.....	4,572,698	113,367

Diminished product.

The year 1876 shows an increase of 8 vessels for Iceland, and yet the above table shows a diminution of 4,572,698 lbs. from the quantity of cod taken, and of $113,367 in the value of the product as compared with that for the year 1875. Being favored by the weather, the fishery on the west coast was very productive; on the other hand, on the east coast and to the south, which localities are usually frequented by the largest number of French fishing boats, the fishery was very unsuccessful on account of bad weather and ice. The second season, as the same influences prevailed, was no better. Fish are always abundant in the vicinity of Iceland; the success of an expedition depends entirely on the state of the atmosphere during the fishing season. Although the diminution in the number taken is considerable, it is to be remarked that that of the product sales is much less so. The fish being scarcer than during the preceding year, prices rose, so that owners found a compensation in this, in which the crews were unable to participate, being for the most part engaged on shares.

French maritime fishing statistics.

Herring fishery

Years	Pounds of fish.	Value.
1875	48,924,942	$1,319,212
1876	57,335,379	1,814,305
Increase in 1876	8,410,437	495,093

Herring fishery.

During the years 1874 and 1875, the herring fishery was put to a severe test, both on account of the marked decrease in the quantity taken and on account of the difficulty of disposing of what was taken at remunerative prices. The various causes which were unfavorable to this industry have been explained in the preceding statistics. Ship-owners and masters of vessels did well not to yield to discouragement, for the year 1876 made amends in a great measure for their losses, showing, in comparison with 1875, an increase of 8,410,437 lbs. in fish, and an increase in value of $495,093. This favorable result is, so to speak, exclusively due to the vessels sent from the port of Boulogne, the other ports whence vessels are sent showing but very slight improvement over the yield of the preceding season.

Boulogne.

The herring fishing at Boulogne, the material for which, both in boats and nets, may be approximately estimated at five millions, yielded in 1876 a net profit of nearly 200 per cent. Naturally the material condition of the seamen of that quarter is affected by the progress made, and the comfort, which is almost general, has an influence upon their moral condition, which is as good as possible.

Report of the local commandant.

In his report at the close of the year 1876, the commandant of the station of the channel and the North Sea expresses himself as follows:

"I think it proper to call attention to one question, which is not sufficiently considered by our ship-owners and salters, in my opinion; I mean the development of our herring trade. It is undoubtedly wise to have a certain run of business, the profits of which are assured; but it is also well to endeavor to enlarge it. In years like that which is just past [1876], when the demand is far in excess of the production, the scarcity in the market has no other inconvenience than the diminution, to a certain extent, of the competition of purchasers. But suppose an abundant year comes, in which foreign and French vessels will glut our market with these products, and then prices fall to such a degree that the fisherman will not find in his occupation a remuneration for his outlay and labor. Let a few such years follow, and the fishing interest will be ruined; experience has shown this.

Necessity for enlarging the market for herring.

"We must, then, look the future in the face, widen our horizon, and study the herring question in a not too limited point of view. It is important to enlarge our market by making every effort possible to increase the consumption of the herring, especially in France. If the market of the North can be useful to us in disposing of the herring of the first fishing, called the Scotch herring, the French market must especially attract our attention for the subsequent periods of the fishery; it is vast enough to absorb alone the entire product of the French fisheries, and more too. What must be done to develop the consumption of these fish in France? The herring must be sold cheap; it must become the food of the laborer, and be no longer an article of luxury. When at a distance of a few kilos from the centers of production we see red herring, which scarcely realize 7 centimes (1¾ cts.) to the seller

French maritime fishing statistics.

quoted at 20 and 25 centimes (4¼ cts.), we must not be astonished if the trade in them is limited. Retailers thus cause our fishermen and our ship-owners an injury of which they are unconscious, but which is none the less real. Let these latter try to have, in all the large centers of France, commission merchants who will sell the herring at reasonable prices, and the consumption, becoming gradually developed, will prevent a glut in the market in years of abundance, and consequently a ruinous fall in the price."

Prices and sales of herring.

Coast fishing.

Coast fishing.

Sardines

SARDINES.

	Number.	Value.
Taken in 1875	980, 628, 110	$2, 457, 147 20
Taken in 1876	1, 198, 402, 181	3, 299, 009 60
Increase for 1876	217, 774, 071	841, 862 40

Seasons of 1875 and 1876.

The season of 1875 was very productive as regards the quantity taken; the increase of sardines taken was 369,033,322 over the preceding year, but prices were low and a fall took place everywhere. The season of 1876 was doubly favored, because in regard to quantity it shows an increase of 217,774,071 sardines above 1875, and in regard to value an increase of $841,862.40; that is to say, that prices were well sustained, notwithstanding the abundance of fish.

The "Beloit" seine.

The Belot seine is still employed for the capture of sardines. This new implement can be worked only by several boats in company. At Douarnenez 24 parties with 48 seines, instead of 35 parties with 80 seines in 1875, took part in 1876 in the fishing operations. The use of these implements gave rise to no further opposition; the public mind became tranquilized with regard to their use, as the fishermen better understood the advantage and disadvantage of their use. Owners of vessels had some difficulty in engaging the necessary crews, and sometimes were not able to continue fishing during the entire season for lack of men. They realized considerable profit, but the share of the crews that fished with the Belot seine was, in 1876, inferior to that of boats using other processes. This inferiority is, so to speak, the only cause of the difficulty of recruiting, and this explains the diminution in the number of vessels using these seines.

The "Eyraud" net.

As to the Eyraud net, which is also used in taking the sardine, some fishermen who have persevered in its use have obtained excellent results. It must be added, however, that others have not found it so advantageous and have therefore abandoned it.

The experience of 1876 is not yet sufficiently conclusive to permit us to reach a final decision as to the value of nets, with regard to which the opinion of fishermen is not yet formed. Modifications have been introduced in the course of the year, in this new kind of instrument, and one of the most active fishermen has taken out a patent for an improvement which seems to be appreciated.

Artificial bait.

Messrs. Morvan & Delassalle, who are the inventors of artificial hard roe, called *Douarnenez roe*, have altered the composition of their bait by making it consist in part of salted flour and a small quantity of Norwegian hard roe, but this new composition has not fully realized their expectations.

On the other hand, M. Ispa, a merchant at Douarnenez, has invented,

under the name of *heterogeneous hard roe*, a bait composed of *tourteaux* (a kind of cake) and oleaginous grain soaked in brine or sea-water. The whole is prepared with a mixture of one-fourth part of Berlin hard roe, and this bait is sold at 20 centimes (4 cents) per kilo (2.20 lbs.), or a little less than the bait of Messrs. Morvan & Delassalle, which costs from 25 to 30 fr. per barrel ($5 to $6). Each barrel contains from 120 to 130 kilos (264 to 286 lbs.). *French maritime fishing statistics.* Sardine fishery.

These two preparations were used in 1876. The favor enjoyed by the *heterogeneous hard roe* of M. Ispa at the outset continued throughout the season. Bait.

If we consider the number of barrels of hard roe of all kinds used during the last fishing season, the comparative situation of the cod roe and the artificial hard roes will be as follows: Cod roe.

Barrels of cod roe	15,000
Barrels of artificial roe	5,000
Total	20,000

The consumption of artificial hard roe represents, therefore, but one-fourth of the total consumption, and in this one-fourth the number of barrels of heterogeneous roe was 3,800 against 1,200 barrels only of the so-called Douarnenez roe and the farinaceous mixture of M. Morvan. According to these figures the Ispa roe possesses, in the opinion of the fisherman, a marked superiority over the other artificial roes, although the comparative experiences of the cutter Moustique and the results obtained by the house of Pellier, of Audierne, tend to show that this superiority is merely imaginary. Artificial roe.

From these comparisons is deduced the fact that the happy result of the appearance of these new kinds of bait in the market has been an influence upon the price of the hard roe of the cod, which comes to us almost exclusively from Norway. The fall in the price of this roe has rendered it possible to fit out a certain number of vessels which would have been idle had they been obliged to pay the old prices for bait.

Fresh fish (indicated by the name of "other kinds," comprising turbots, brills, soles, flounders, plaices, rays, red mullet, whiting, conger, lamprey, sturgeons, etc.). Fresh fish.

Year	Number of men employed.	Number of boats.	Tonnage.	Number of pounds of fish taken.	Value.
1875	68,651	*20,157	101,852	90,860,266	$5,459,407 60
1876	68,317	20,662	102,090	93,727,384	5,838,392 40
Increase in 1876		505	238	2,867,118	378,984 80
Decrease in 1876	334				

*By these figures is shown the number of vessels which have been engaged in the fishery of the herring, mackerel, sardine, anchovy, oyster, mussel, other shell-fish, crustacea, and shrimp. These boats are engaged in taking these different fish alternately.

The taking of fresh fish progresses from year to year gradually, it is true, but constantly. The improvement realized in 1876 is satisfactory, since it shows an increase of 1,257,781 kilos (2,867,118 lbs.) of fish and

French maritime fishing statistics.

an increase in value of 1,894,924 fr. ($378,984.80). These improvements in quantity and value, compared with each other, show that the prices of fresh fish held firm, and that they are even rising.

Fresh fish.

The fishery of fresh mackerel was exceptionally abundant on the coast of Brittany in 1876.

Subventions to fishermen

In my report of last year I stated to the minister the considerations which had induced the marine department to grant subsidies to certain fishermen on the coast of Brittany to aid them in constructing vessels on the most improved model and of a heavy tonnage, suitable for fishing in the open sea. The department, in making such grants, designed to demonstrate to the fishermen of Brittany that fishing in the open sea, under favorable conditions, must be more profitable than that which they habitually practice along the coasts on fishing grounds which are exhausted by constant fishing. The anticipations of the department were realized, and the result obtained will probably afford useful instruction to the fishermen, and also to many persons who naturally do not now dare to invest their capital in fishing operations in associating themselves with experienced and courageous seamen. Thus, the model vessel Amphitrite, of Croisic, the purchase price of which was about 12,000 fr. ($2,400), gained during the year 1876, deducting all expenses, the sum of 5,347 fr. 90 centimes ($1,069.58), or nearly 50 per cent. on the capital invested, which was of course highly profitable. Another model vessel—that of Etel (district of Auray)—which has not yet been engaged for a full year, shows also excellent results, without, however, having reached the figures realized by the Amphitrite.

Steam fishing-vessels.

At Rochelle and at Teste, the steam vessels successfully continued their operatitons in fishing with drag-nets. In the former of the above-mentioned ports, the year 1876 saw the number of vessels increased by one, which makes the number employed there five. At Teste, the improvement shown in the yield is due in a great measure to the steam vessels which, by the rapidity and safety of their navigation, offer such advantages, that the time can be foreseen when the drag-net fishery on the coasts in this district will be no longer carried on, save with the aid of these vessels.

Madraques.

Four madraques (large tunny-nets), recently manufactured, were cast into the sea in 1876 off the shore of the subarrondissement of Toulon, namely, the madragues of Brusq and of Grand Rouveau (district of the Seyne), that of Giens (subdistrict of Hyères), and finally that of the Canoubiers (district of Saint-Tropez). These fisheries yielded 55,538 kilos (121,173 lbs.) of fish of various kinds, principally tunny, representing a money value of 65,180 fr. ($13,036). They employed men, engaged by the month at fixed wages. The master-in-chief received from 100 to 125 fr. ($20 to $25), the master of each vessel 80 fr. ($16), the seamen from 55 to 70 fr. ($11 to $14), and the cabin-boy 45 fr. ($9). The price of the tunny varied, before the establishment of the madrague on the shore of the department of Var, between 2 fr. 50 centimes (50 cents) and 4 fr. (80 cents) per kilo (2.20 lbs). In 1876 the maximum price was 1 fr. 70 centimes (34 cents) per kilo at Toulon, and 1 fr. 40 centimes (28 cents) in the neighborhood of the market. The minimum price was 1 fr. (20 cents) per kilo. So remarkable a fall in the price of so useful an article of food could not but exert a happy influence upon the welfare of the people living near the sea. Thus, the custom of pickling the tunny, which for more than thirty years had been abandoned in their families, on account of the scarcity of this fish, is again come into use.

Tunny.

The madragues used in 1876 at Cette, at Martigues, and at Marseilles took 170,855 kilos (375,881 lbs.) of fish, which sold for 231,502 fr. ($46,300.40). *French maritime fishing statistics.*

* * * * * * *

Finally, the season of 1876 was finished under conditions as satisfactory as posssible. From most of the maritime districts it is reported that the condition of the fishermen is visibly improved, owing to the good yield of the fisheries. Madraques.

The statistics of the maritime fisheries, as well as of the river fisheries which precede them, are published annually.

I have the honor to beg the minister to be pleased to order that the statistics and the report which I now submit be published likewise. M. De Bon.

(Signed) DE BON,

Commissary-General and Director of the Departmental Service.

Approved.

(Signed) GICQUEL DES TOUCHES.

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Arabia, Argentine Republic, Austria-Hungary (with provinces), Barbary, Belgium, China, Denmark, Egypt, France (with Algeria), Germany (with individual states), Great Britain (with colonies), Greece, Italy, Netherlands, Norway, Persia, Portugal, Roumania, Russia (with Finland), Servia, Spain, Sweden, Switzerland, Syria, Turkey, United States (with individual States).

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Brazil,	Italy,	Syria,
China,	Japan,	Tunis,
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Arabia,	Germany,	Roumania,
Argentine Republic,	Great Britain, etc.,	Russia (with Finland),
Austria-Hungary,	Greece,	Spain,
Barbary,	Italy,	Sweden,
Belgium,	Netherlands,	Switzerland,
China,	Norway,	Syria,
Denmark,	Persia,	United States.]
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